

3.

The Templeton Crocker Expedition. XIII. Penaeidae from the
Region of Lower California and Clarion Island,
with Descriptions of Four New Species.¹

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(Text-figures 1-34).

[Note: This is the thirteenth of a series of papers dealing with the specimens collected on the Twenty-fourth or Templeton Crocker Expedition of the Department of Tropical Research of the New York Zoological Society; William Beebe, Director. For data on dredges, localities, dates, etc., concerning the capture of specimens treated in this paper, refer to the Volume XXII of *Zoologica*, No. 2 pp. 33 to 46. Unless otherwise noted the catalogue and station numbers referred to relate to the above-mentioned expedition.]

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INTRODUCTION.

Of the seventeen or eighteen species of Penaeidae represented in the present collection, more than half were previously known more or less incompletely if at all. There are no less than five species in the collection which have not heretofore been recorded from Pacific America, of which three are new to science; in addition the material aids in the resurrection of a named species not generally recognized as valid and in the completion of descriptions of five species hitherto known only from juveniles or from a single sex, and also assists in the recognition as a new species of one form not included in the collection. That so large a part of the gathering is of the ultimate in systematic value is a tribute not only to the surprising richness of the region but to the capacity of those by whom the material was obtained. I am deeply indebted to Dr. William Beebe, the Director of the Expedition, and to his associates, for so valuable an opportunity to continue a study of the Pacific American peneids.

In a previous paper (Burkenroad, 1936, p. 6), it was stated that whereas the littoral peneids of the Atlantic and Pacific coasts of America are much more nearly related each to the fauna of the other coast than is either to the fauna of any other region, the deep-water peneids of the two regions seem to exhibit the inverse relationship. In explanation of this reversal of degree of relationship, it was suggested that the littoral peneids of the two coasts have had contacts less intimate (in terms of epoch and intensity) with the peneids of other regions than were their contacts with each other supplied by shallow Pleistocene and preceding transcontinental channels. It was suggested that by contrast, the oceanic faunas of the two coasts have presumably had no direct communication since the elevation of the Panama ridge before the late Cretaceous and have at the same time by their oceanic habit perhaps been placed in communication with

the faunas of other regions with relatively greater frequency than have the littoral forms. The new records supplied by the present collection are in agreement with the arrangement suggested above. Of the two newly added deep-water species, *Gennadas sordidus* is otherwise known only from the Indo-Pacific; while *G. scutatus*, although it occurs in the American Atlantic, is also known from the intervening Indo-Pacific regions.

It seems of interest to observe that the proportion of Eusicyoninae to Penaeinae in the region of Lower California is rather different from what seems usual elsewhere, the Eusicyoninae forming a relatively very conspicuous part of the littoral population. Thus, for instance, DeMan, 1911, records as the catch of the *Siboga* in East Indian waters 388 specimens of Penaeinae of about 30 species to 19 specimens of Eusicyoninae of 9 species (a ratio which I believe to be not unusual in unselected collections from most parts of the world). The *Zaca* took 156 specimens of Eusicyoninae of 7 or 8 species to 182 specimens of Penaeinae of 5 species, and the *Pawnee* in 1926 took 92 specimens of Eusicyoninae of 4 species to 43 of Penaeinae of 3 species, in the Lower California region.

GENNADAS Bate.

Gennadas, Burkenroad, 1936, p. 59.

***Gennadas sordidus* Kemp.**

Gennadas sordidus, Kemp, 1910, p. 177.

Amalopenaeus sordidus, Balss, 1927, p. 262.

(Text-figure 1).

Range: Indian Ocean off India; Pacific off Lower California, Gulf of California; in midwater.

Material: A total of 37 specimens (about one-third of them males) was taken in the Gulf of California in the general neighborhood of Tortuga (Station 139) and San Ildefonso (Station 148) Islands; in the mouth of the Gulf of California (Stations 158 and 159); off the southern tip of Lower California (Station 134), and north of the Revillagigedo Islands (Station 165), at depths above 300 to 500 fathoms both inside and outside the 1,000 fathom contour, as follows:

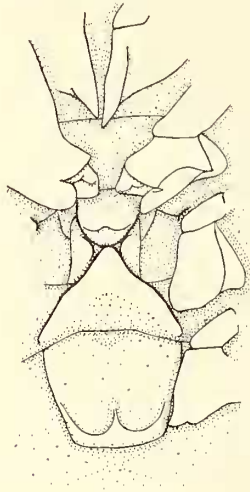
Station 130: T-1 (1 ♂); Station 134: T-2 (2 ♀), T-3 (1 ♀); Station 139: T-2 (1 ♂), T-3 (1 ♂), T-4 (1 ♀); Station 148: T-2 (1 ♀), T-4 (2 ♂, 5 ♀); Station 158: T-4 (2 ♂, 7 ♀); Station 159: T-2 (1 ♂, 2 ♀), T-3 (2 ♂, 4 ♀); Station 165: T-3 (3 ♂, 1 ♀). Cat. Nos. 36,950, 36,951, 36,952, 36,953, 36,954, 36,955, 36,956, 36,957, 36,958, 36,959, 36,960, 36,961.

Dimensions and Sexual Condition: Material ranges from adult individuals of carapace length 11 mm., total about 32 mm., to an uncertainly determinable early post-mysis probably of this species, of carapace 2 mm. The petasmas are united in males above 8 mm. carapace length; females may and usually do bear ripened ovaries above 9 mm. Of the twelve fruitful hauls, the six made at 500 fathoms or more accounted for 28 of the 37 specimens; no clear indication of segregation according to size is apparent.

Remarks: The present Pacific American catches of *Gennadas sordidus* are unexpected, inasmuch as previous records have suggested a localization of the species in the Indian Ocean.

The female of the species has not previously been described. The thelycum bears a very great resemblance to that of *G. parvus* Bate, from which it differs in the slighter development of the median longitudinal carina of sternite XIV, the more narrowed anterior portion of the triangular

shield of sternite XIII, and the smaller size of the protuberance at the sides of sternite XIII behind the bases of the third legs. The median carina of XIV is variable in length and definition, ranging in form from a short, tooth-like crest at the posterior margin of the sternite to a very low ridge fading out anteriorly before it reaches a third of the way to the anterior margin (although a faint trace of median elevation sometimes reappears on the anterior part of the sternite and is very occasionally continuous with the more perceptible posterior ridge). In *G. parvus* the much stronger carina of XIV displays comparable variations, but seems always to reach beyond the anterior third of the sternite. The protuberance behind the bases of the third legs varies in strength in *G. sordidus* from complete absence to a low and inconspicuous weakly setose swelling (and is even, in one specimen, a conspicuous projection); but it seems never to acquire the strength of its homologue in *G. parvus*, which reaches as far median as to the lips of the openings of the sperm receptacles.



Text-figure 1.

Gennadas sordidus Kemp. Thelycum; adult ♀, D. T. R. 36,960, x 13.

The petasma of *G. sordidus* is adequately represented by Balss, 1927, fig. 18. It differs from that of *G. parvus* most conspicuously in that the distoventral lobe is not clearly subdivided, the cleft between the lobules in *G. parvus* being represented in *G. sordidus* only by a slight crenellation of the margin of the lobe and a short vertical crest on its posterior face (somewhat as in *G. tinayrei*); and also in that the accessory and the distomedian lobes are not subdivided, as they are in *G. parvus*.

In my discussion of *Gennadas* in 1936, p. 85, I have stated, on the basis of the undivided form of the distolateral lobe, that "The only other species of which the female is unknown, *G. sordidus* Kemp, undoubtedly belongs to a different section [I], and may be predicted with some confidence to have a thelycum with separated, independent spermathecal orifices;" a prediction which now stands confirmed. In a key to the species (1936, p. 64), however, *G. sordidus* has been placed in Group I A with the species (*G. capensis* and *G. kempfi*) in which the distoventral lobe of the petasma is undivided and the orifices of the sperm receptacles very widely separated and not guarded posteriorly by conspicuous prominences; rather than in Group I B of forms (*G. elegans*, *G. breviostris*, *G. tinayrei*, *G. parvus*) with divided distoventral lobe and guarded and less widely separated spermathecal orifices. The structure of the female of *G. sordidus* is clearly that of Group I B; and it is evident that I was mistaken in ignoring the trace of a

cleft in the distal border of the distoventral lobe of the petasma indicated in Balss' figure (but not, however, in that of Kemp, 1910, plate XIV, figs. 1, 2). It may be observed that both Kemp and Balss have placed the male of *G. sordidus* in its correct relationship, as most closely allied to *G. parvus*.

The diagnostic key published by me in 1936 thus requires to be modified by elimination of I A 1 and transfer of *G. sordidus* to I B 2 b (2) as follows:

I B 2 b (2). MALE. Distolateral lobe much narrower than the distoventral, and not reaching so far distally as does the latter; accessory lobe much larger than the distolateral.

FEMALE. Elevation of XIV with a median longitudinal ridge.

I B 2 b (2) (a) MALE. Division of the distoventral lobe indicated only by a slight crenellation and thickening of the margin; accessory and distomedian lobes entire.

FEMALE. Median longitudinal ridge of XIV very short, not well defined, if present, on the anterior two-thirds of the sternite.

6. *G. sordidus* Kemp; Balss, 1927, ♂ [♀, figure 1].

I B 2 b (2) (b). MALE. Distoventral lobe conspicuously bipartite; accessory lobe tripartite; distomedian lobe bipartite.

FEMALE. Median longitudinal ridge of XIV well defined and extending two-thirds or more the length of the sternite.

7. *G. parvus* Bate; Balss, 1927, ♂ and ♀.

***Gennadas scutatus* Bouvier.**

Gennadas scutatus, Bouvier, 1906, p. 9; Burkenroad, 1936, p. 83.

Gennadas clavicarpus, part, DeMan, 1911, p. 19.

? *Gennadas clavicarpus*, Boone, 1930, p. 129.

Range: Cosmopolitan, in midwater.

Material: Two female specimens were taken 145 miles north of Clarion Island (Station 165 T-3), 20° 36' N. Lat., 115° 07' W. Long., at a depth above 500 fathoms (Cat. No. 36,962).

Dimensions and Sexual Condition: Carapace length 9 mm., total about 31 mm. The specimens equal in length the largest heretofore recorded (Milne Edwards and Bouvier, 1909, p. 194). Both have well-developed ovaries; in one a small mass of material in one sperm-receptacle seems to mark an interrupted mating.

Remarks: The record from Pacific America is new.²

The present material differs in genital sculpture from that known from the Atlantic and the Indo-Pacific in that the free flap from the anterior margin of the fourteenth sternite is very slender (about three times as long as broad), tapering, and pointed, being widest at the base; the anterior margin of the anterior lip of the sperm receptacles is heavily setose; there are a pair of conspicuous setose prominences between the bases of the fourth pair of legs; and the coxal projection of the fourth legs has an elongate deeply concave distal margin. Comparison of the present specimens and others (including both sexes) taken by the *Arcturus* in the American Pacific, with Atlantic material of *G. scutatus* in the Bingham Oceanographic Collection and with the literature, leads however to the belief that the *Zaca* females are to be considered as an extreme variation falling within the specific limits.

² It is possible that the record by Boone, 1930, of "*Gennadas clavicarpus* DeMan" from off Cape Mala, may refer to the present species. However, although Miss Boone's description of the petasma applies to *Gennadas scutatus*, her description of the thelycum applies to *Gennadas propinquus* Rathbun, just as in the account of "*G. clavicarpus*" by DeMan, and what her specimens may actually correspond to therefore seems doubtful.

In females of *G. scutatus* from the Gulf of Mexico and the Caribbean, the free flap of XIV is very broad, not more than one and one-third times as long as wide. In Plate II, figure 3k, DeMan, 1911, of the thelycum of an Indo-Pacific female of *G. scutatus* ("*G. clavicarpus*"), the flap is shown as about one and three-quarters times as long as wide; in Bouvier's figure of a North Atlantic female (1906, fig. 8), as two and one-third times as long as wide. In an *Arcturus* female from the American Pacific the flap is two and one-third times as long as wide. In available Atlantic females the tip of the flap is sometimes truncate or even emarginate, sometimes pointed.

The Atlantic females bear a pair of very inconspicuous and weakly setose prominences, placed just median to the bases of the fourth legs; these prominences, which were overlooked in my previous account, seem the equivalents of the much more conspicuous ones in the *Zaca* females; and indeed, are not very much less distinct in Atlantic specimens than in small *Arcturus* females from the American Pacific.

The inner margin of the coxa of the fourth legs in Atlantic females generally resembles that indicated in DeMan's Plate II, figure 3k, of an Indo-Pacific specimen; in some Atlantic females, however, the distal projection is farther below the coxobasial articulation and is more pronounced, thus approaching the form characteristic of the Pacific American specimens.

Finally, the petasma of an *Arcturus* male from the American Pacific, as compared with the same organ in Atlantic specimens, seems to show no differences lying outside the range of those fairly considerable variations in relative length of the different lobules which are indicated in the literature.

HYMENOPENAEUS Smith.

Hymenopenaeus, Burkenroad, 1936, pp. 101, 102.

***Hymenopenaeus doris* (Faxon).**

Haliporus doris, Faxon, 1893, p. 214; 1895, p. 191.

Range: Off the Pacific coasts of southern Mexico and Guatemala; mouth of the Gulf of California. Midwater (300-500 fathoms) and bottom, in 1,500-2,000 fathoms.

Material: One female was taken in the mouth of the Gulf of California (Station 159 T-3, Cat. No. 36,963) at a depth above 500 fathoms.

Dimensions and Sexual Condition: The specimen is a juvenile of carapace 9 mm., total length about 29 mm.

Remarks: The thelycum of the present small female differs considerably from that of the much larger types of *H. doris* in that the median vertical projection of the posterior margin of the thirteenth sternite has a very bluntly acuminate rather than a truncated distal margin; and the pair of projections laterally flanking the median projection are very much lower than the median one instead of reaching as high as it does. The posterior margin the twelfth sternite lacks the pair of posteriorly directed projections present in the types.

In my opinion, the thelycum described above cannot be that of a juvenile of *H. nereus*, particularly since a strong cusp like that of the adult *H. doris* is present on the fourteenth sternite, instead of the low untoothed ridge of *H. nereus* adult. In Penaeinae, a tooth or spine is usually present on the fourteenth sternite in larval or juvenile stages, which may later disappear in the adult. According, however, to the results of examination of mysis and post-mysis larvae and of juveniles of Solenocerinae, a tooth develops on the fourteenth sternite of this subfamily only in juveniles of species which continue to bear it as adult.

As to whether the present specimen actually refers to *H. doris* rather

than to some undescribed form it is impossible to be certain. However, the thelycum in juveniles of the closely related species *H. laevis* differs from that of adults in somewhat the same manner as, although to a lesser degree than, the thelycum of the present juvenile differs from that of *H. doris*.

A comparison of the present specimen of *H. doris* and of another similar but still smaller juvenile with two adult females of *H. nereus* (the three last-mentioned specimens being undescribed Pacific American material taken by the *Arcturus*), reveals no striking differences between the two forms other than those in genitalia. A less detailed comparison of the female types of *H. nereus* with those of *H. doris* (the males being known in the former species only), made during a visit to the Museum of Comparative Zoology, also indicated that, about as stated by Faxon, the two species agree so closely except in thelycum "that one description would serve for both." Both forms are extremely like *H. laevis* (Bate), and differ from the remainder of the genus [save possibly *H. villosus* (Alcock and Anderson)] in bearing both pterygostomial and branchiostegal spines (cf. Burkenroad, 1936, pp. 103 seq.). The only non-genital differences from *H. laevis* seem to be that the eyes are somewhat larger in the two Pacific American species and the tip of the telson, beyond the lateral spines, is more slender and elongate than in *H. laevis*.

It may be noted that in a preceding reference to *H. nereus* and *H. doris* (1936, p. 111), I have done an injustice to Faxon by the incorrect statement that "only three" of the five teeth arming the median lobule of the distolateral lobe of the petasma of *H. nereus* "are indicated in Faxon's figure."

Faxon (1895, p. 192) calls attention to the possibility that those of his specimens of *H. doris* which were obtained at Albatross Station 3414 might possibly have been taken pelagically, inasmuch as Agassiz records the capture of some "transparent Penaeidae" in the tow-net at this station; it is possible, however, that Agassiz refers to the "*Sergestes edwardsii* Kr." which Faxon records from Station 3414. On the other hand, there is no possible doubt that the present juvenile of *H. doris*, and another taken by the *Arcturus* off Cocos Island at 300 fms., were captured pelagically, since both were caught in nets lowered to not more than 500 fathoms, in areas well outside the 1,000-fathom contour. In the present Californian juvenile, the statocyst contains a flattened agglomeration of transparent, sharp, irregularly shaped granules, the largest of which is about 0.15 mm. in greatest dimension. These granules, which are not affected by dilute HCl, appear siliceous; although they are rather readily fractured by pressure with the dissecting needle. In the Cocos juvenile, the statocyst contains a flattened plate of the delicate shells of minute pelagic foraminifera cemented together with cuticular secretion. In two large specimens of *Hymenopenaeus nereus*, taken by the *Arcturus* on bottom at Station 74 and examined for comparison, the statolith is composed of pelagic foraminifera, heavy calcareous fragments apparently of molluscan shells, and granules of siliceous appearance similar in nature to those composing the statolith of the Californian juvenile of *H. doris*. I am inclined to think that as in the case of the pelagically captured specimens of *H. laevis* and *H. aphoticus* discussed by Burkenroad, 1936, p. 106, the present juveniles of *H. doris* had obtained their statoliths from bottom, and had later swum up to the levels where they were captured.

SOLENOCERA Lucas.

***Solenocera mutator*, sp. nov.**

(Text-figures 2-5).

Type: Type male and cotypes: Cat. No. 36,969, Department of Tropical Research, New York Zoological Society; taken at Station 150, Dredge 5

(5 ♂, 2 ♀); from Gorda Banks, tip of Lower California, 23° 01' 30" N. Lat., 109° 30' W. Long., 4-foot dredge at 40 to 100 fathoms; April 21, 1936.

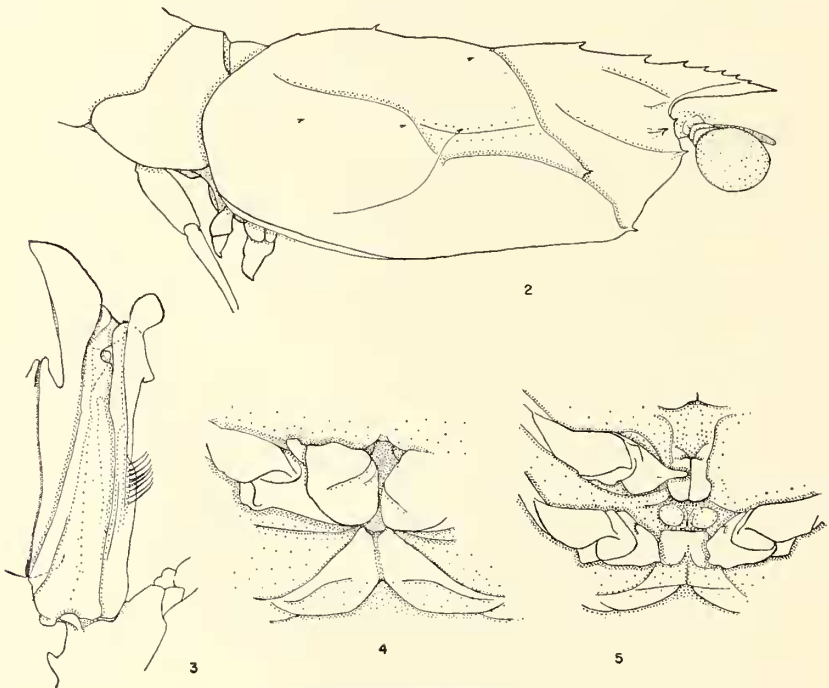
Range: Bay of Panama; Pacific coast of Mexico off Manzanillo and Mazatlan; Lower California, both coasts; 20-117 fathoms.

Material: A total of 33 specimens (somewhat more than half of them males) was taken, at depths of 20 to 100 fathoms, east of Cedros Island (Stations 125 and 126), in Santa Inez Bay (Stations 141 and 143), on Gorda Bank (Station 150) and off Mazatlan (Stations 154 and 155), as follows:

Station 125: D-1 (2 ♂); Station 126: D-3 (2 ♂, 1 ♀), D-4 (1 ♂, 1 ♀); Station 141: D-4 (1 ♂, 1 ♀); Station 143: D-3 (5 ♂, 2 ♀); Station 150: D-5 (5 ♂, 2 ♀); Station 154: D-1 (3 ♀ plus 1 fragment); Station 155: (3 ♂, 3 ♀). Cat. Nos. 36,964, 36,965, 36,966, 36,967, 36,968, 36,969, 36,970, 36,971.

In addition to this material, I have been enabled through the kindness of Dr. W. L. Schmitt of the U. S. National Museum to examine four males ranging in carapace length from 12 to 13.5 mm. and five females ranging in carapace length from 12.5 to 16 mm., taken off Manzanillo, Mexico, in 117 fathoms (U. S. N. M. 28489); as well as a large female 19 mm. in carapace length from Panama Bay (*Albatross* Station 2804) at a depth of 47 fathoms (U. S. N. M. 28488).

Dimensions and Sexual Condition: Males ranging in size from carapace length 16 mm., total about 62 mm., to carapace 9 mm.; females from carapace 14 mm., total 56 mm., to carapace 7 mm. In the four males of



Text-figures 2-5.

Solenocera mutator, n. sp. 2. Carapace (lateral view); juvenile Mazatlan ♀, D. T. R. 36,970, x 6. 3. Petasma (left half, posterior view); type ♂, T. R. 36,969, x 6. 4. Fourteenth sternite; adult ♂, D. T. R. 36,965, x 6. Thelycum; subadult ♀, D. T. R. 36,968, x 6.

carapace 10 mm. or less, and in one of carapace 11 mm., the petasmal endopods are unjoined; in the rest, of carapace 11 mm. or more, the petasma is of adult form.

Diagnosis: Pterygostomian spine meeting the frontal margin at nearly a right angle; cervical carina not notched above the level of the hepatic tooth; postorbital spine well developed; orbital angle dentiform. Cervical sulcus not continuous across the dorsum; postrostral carina of the carapace obliterated behind the level of the cervical sulcus. The rostrum is short and deep, with convex ventral margin; it bears from 5 to 7, usually 6, teeth in addition to the epigastric, of which the posteriormost (and sometimes the preceding also) is behind the orbit. The posteriormost tooth of the rostral series is separated from the preceding by an interspace equal to one-third to one-fifth, usually more than one-fourth, of the interval between the posteriormost rostral tooth and the dorsal end of the cervical sulcus. The epigastric tooth is placed at a point from three-fifths to more than two-thirds, usually about two-thirds, of the way from the orbital margin to the cervical sulcus. In specimens from other localities than Lower California there is a small slender spine on the dorsum of the carapace near its posterior end, and still other spines not present in Lower Californian material may occur on carapace and pleon. It is to the inconstant presence of this armature that the specific name refers.

The fourth, fifth and sixth pleonic somites are dorsally carinated; the third rather weakly ridged. The telson is short, with a conspicuous pair of fixed marginal teeth.

The antennular flagella vary from somewhat shorter than the carapace minus the rostrum, to more than one and two-thirds this length. They are usually quite slender, except in a few of the larger males where the distal portion of the inferior flagellum is expanded to twice its basal breadth.

The emargination of the posterior end of the fourteenth sternite of the male is deep but broad. The paired teeth of the anterior part of the fourteenth sternite of the female are usually represented by broad, low, obtuse swellings; which may in large specimens, however, be somewhat produced, acuminate and turned medioanteriorly. The posterior margin of the thirteenth sternite of the female is, although narrowly incised by a median groove, on the whole conspicuously convex; the V-shaped anterior edge of the posterior part of the sternite is sharply defined; the anterior part of the sternite bears a low ridge not rising into a setose protuberance at its hinder end. The coxae of the fourth legs of the female are often considerably produced, so that they may overlap considerably in the midline.

The petasma is particularly characterized by the considerable size of the triangular lamellate projection of the dorsal face of the distolateral lobe (which is even visible in ventral view, projecting beyond the lateral margin of its lobe); and by the elongated subtriangular shape of the acuminate median lobule of the distolateral lobe. The distoventral lobe is crowned by a free distoventral projection.

Remarks: In a preceding paper (1936, p. 123), I have described in detail, under the heading "*Solenocera* species," a small male with joined petasmal endopods taken in the Gulf of Panama, which differs in several respects from the much larger types of *S. agassizii* Faxon from the same region. It was thought possible at that time that this specimen might represent a young form of *S. agassizii*; chiefly for the reason that a small female of *Solenocera* from the Gulf of Mexico, described in the same paper (1936, p. 122) under the heading "*Solenocera vioscai* Burkenroad" and regarded as a young adult of that species, was found to differ in bodily characters from the much larger types of *S. vioscai* in somewhat the same manner as the small Panamanian male differed from the types of *S. agassizii*.

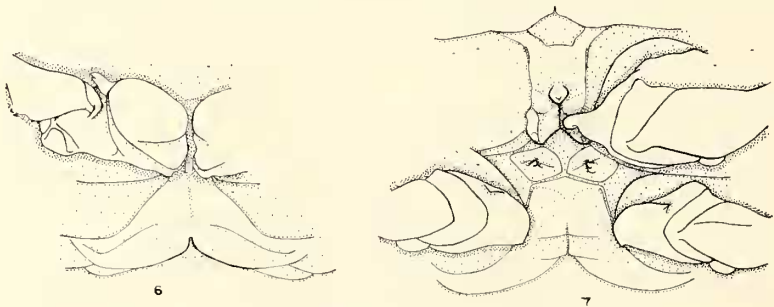
A study of the very much more adequate material of *Solenocera* from

American waters which has now become available from various sources, demonstrates, however, that not only do both "*Solenocera* species" and the supposed young specimen of *S. vioscai* represent species distinct from those to which it was previously thought that they might refer, but there are still other distinct forms, one from the Gulf of Mexico, and the present one included in the *Zaca* collection. The American species of the genus therefore number six, of which only two, *S. agassizii* Faxon and *S. vioscai* Burkenroad, have been named until the present. The third form, *S. mutator* sp. nov., has been named and diagnosed in preceding paragraphs. A fourth form is a peculiar one from the Gulf of Mexico represented by the supposed "juvenile" erroneously referred to *S. vioscai* in 1936; a fifth form, also from the Gulf of Mexico, is closely related to *S. mutator*; these will be described in a forthcoming paper. The sixth form, the "*Solenocera* species" from Panama, which is also closely related to *S. mutator*, may be given a name in this place, as follows:

***Solenocera florea*, sp. nov.**

Solenocera florea, sp. nov. Holotype, B. O. C. No. 132 (a male described by Burkenroad, 1936, p. 123, figs. 68-69). Paratypes (Text-figs. 6-7 below) U. S. N. M. No. 28486, five males and five females, all adult, taken in Panama Bay at a depth of 33 fathoms. The paratype material has been made available to me by the very great kindness of Dr. W. L. Schmitt of the U. S. National Museum. The males range in size from carapace 17.2 mm., total length 68 mm., to carapace 15 mm.; the females from carapace 22.8 mm., total length 77 mm. to carapace 21.5 mm. The paratype material agrees very well with the previous description of the holotype; it may however be noted that the antennal scale usually overtops the antennular peduncle by a fifteenth or more of the length of the scale. The figure of the petasma of the holotype (Burkenroad, 1936, fig. 69) is in error, in that the distal margin of the median lobule of the distolateral lobe should be shown as folded over anteriorly, not posteriorly; the description is also in error in that the "pair of rigid lamellar projections" on the posterior face of the distolateral lobe actually represent the two ends of a single lamella, the midsection of which is broken in the holotype. Diagnostic distinctions between *S. florea* and related species of the genus are given in succeeding paragraphs.

The three Pacific American species of *Solenocera* are distinguished from their three Atlantic American congeners by the fact that the blade of the epipodite of the tenth through thirteenth somites is in all of the former deeply bifurcate, the shorter ramus being half or more the length of the undivided portion of the blade (not including peduncle); whereas in the



Text-figures 6 & 7.

Solenocera florea, n. sp. 6. Fourteenth sternite; adult, U. S. N. M. 28,486, x 5. 7. Thelycum; adult ♀, U. S. N. M. 28,486, x 5.

Atlantic forms the epipodites are only shallowly furcated or even mitten-like, the shorter ramus being at most less than a third as long as the undivided portion of the blade. *S. mutator*, *S. florea* and one of the undescribed species from the Gulf of Mexico are all three distinguished from *S. agassizii* and *S. vioscai* by their less numerous rostral teeth (minimum 6, maximum 8 in the former as compared with minimum 8, maximum 10 in the latter); the right angle made by the juncture of their pterygostomial spine with the frontal margin of the carapace dorsal to it, this juncture being a smooth concavity in the two latter forms; and the presence of a scale-like projection on the anterior face of the distolateral lobe of their petasma, which is not represented in *S. vioscai* and *S. agassizii*. The former three species are also, so far as their maxima are known, smaller (55-80 mm.) than the latter two (total lengths respectively exceeding 100 and 200 mm.). The second unnamed species from the Gulf of Mexico, which was erroneously described as the juvenile of *S. vioscai* in 1936, agrees with the *S. mutator* group as regards number of rostral teeth, but with the *S. agassizii* group in pterygostomial spine; its petasma is unknown.

In non-sexual characters, typical (Californian) material of *S. mutator* is not very easily distinguished from *S. florea* although the epigastric tooth of the latter is usually placed somewhat nearer to the orbit (only about one and one-quarter times as far from the orbit as from the cervical sulcus) and the posteriormost tooth of its rostral series is less widely separated from the tooth preceding it (interval between the two teeth from a fourth to a fifth of that between the posterior tooth and the cervical sulcus) than in *S. mutator*. The scale of the inner margin of the basal segment of the antennular peduncle (prosertema) of *S. florea*, which reaches well beyond the eye, seems to be longer than that of *S. mutator*.

Females of *S. florea* are readily distinguished from those of *S. mutator* by the fact that in the former the posterior margin of the thirteenth sternite is acutely concave rather than roundedly convex; and that there is no sharp boundary between the anterior and posterior parts of the same sternite except medially, where the median groove of the posterior part of the sternite ends at a conspicuous, unpaired, setose conical projection set just in advance of the fourth legs. The pair of teeth of the anterior part of the fourteenth sternite also seems to be somewhat more sharp and slender in females of *S. florea*, and the coxal nubs of the fourth legs are less extended than is sometimes the case in *S. mutator*.

The emargination of the posterior edge of the fourteenth sternite is a narrow notch with parallel sides in males of *S. florea*, rather than a sloping concavity as in *S. mutator*. In petasma the two species are strikingly different; particularly as regards the subtriangular rather than subrectangular shape of the median lobule of the distolateral lobe of *S. mutator*, and the form of the distoventral lobe which is in *S. mutator* very nearly identical with that in *S. agassizii*.

Certain peculiar variations in structure within the material which I have here assigned to *Solenocera mutator* seem to require attention. In the specimens from Mexico and Panama, the integument is thin and membranous, the tissues are rather flabby, and the pleon seems relatively quite slender. In Californian material, on the contrary, the integument is thick and rigid, the flesh solid, and the habitus is of the Penaeine type usual in the American species of the genus. These differences are difficult to define precisely, and there is considerable intergradation between the groups; but nevertheless specimens from Lower California do give a general impression different from that of the Mexican material. That this impression may not be the result of differences in method of preservation is suggested by the fact that the Lower Californian and one of the available lots of Mexican material are derived from one collection, the other lot of Mexican and Panamanian material from another.

Of more precisely definable differences between the peninsular and the mainland material of *S. mutator*, in all but one of the nineteen Mexican and Panamanian specimens the dorsum of the carapace about midway between the cervical sulcus and the posterior margin bears a small, slender spine which is absent in all of the twenty-four Californian specimens. In the mainland material there is also a well-developed vestige of the posterior dorsal organ found in many peneid larvae, which is not perceptible in Californian specimens. In small mainland specimens from Mazatlan (the smallest a female of carapace length 9 mm.), the carapace bears four additional pairs of spines of which no traces appear in peninsular specimens, two pairs on the branchial region below the cardiaco-branchial carina, and two pairs on the sides behind the cervical sulcus. The cardiaco-branchial carina, which is in Californian specimens obsolescent, is in these small individuals strongly developed; and there is also a short carina, not represented in peninsular material, which runs between the posterior section of the cardiaco-branchialis and the cervical carina. One of the pairs of lateral spines is set on the middle of this carina, from the midpoint of which another ridge not perceptible in Californian specimens slants in a sinuous oblique toward the posteroventral margin of the carapace. There is also in these small specimens a spine at the posterior end of the dorsal carina of the fourth and fifth pleonic somites as well as of the sixth to which such spines are limited in the peninsular material. Altogether, the small specimens recall to mind in many ways various of the species of *Hymenopenaeus*; thus the carapacic carination and pleonic armature, as well as the habitus, are to some extent comparable with those of *H. laevis* (Bate); the dorso-lateral postcervical spines with the pair present in *H. diomedeeae* (Faxon) (or in *Solenocera hextii* Wood Mason); and the posterior dorsal spine of the carapace with that of *H. steindachneri* (Balss). In somewhat larger specimens from Mazatlan, the extra carapacic carinae are weaker, and the extra lateral spines of the carapace and the posterior spine of the fourth pleonic somite are absent, although the dorsal carapacic spine and that of the fifth pleonic somite are present. In the largest specimen from Mazatlan, a male of carapace length 13.5 mm., all of the extra spines of carapace and pleon are absent and the animal nearly approaches the Californian types in habitus. In all available specimens from Manzanillo, of whatever size, the dorsal spine and the two dorsal of the extra lateral pairs are present. A spine is present on the fifth pleonic somite in all but one small male from Manzanillo; that of the fourth pleonic somite occurs in only two of the ten specimens. In the large female from Panama, of carapace length 19 mm., the dorsal and two pairs of extra lateral carapacic spines are present, but only the sixth pleonic somite is dorsally armed.

There are a number of other inconstant differences between mainland and peninsular material; thus there are eight rostral teeth in 5 of 7 Mazatlan specimens and in 2 of 9 Manzanillo specimens as compared with a maximum of seven in all of the 22 Californian individuals with unbroken rostrum; and the antennular flagella are shorter, or at most no more than slightly longer, than the carapace in Mazatlan and Manzanillo specimens.

However, despite the many differences pointed out above, the mainland and the peninsular specimens are identical in petasma and thelycum, and for this reason I am unable to consider them as systematically distinct. It seems possible, especially because of the change with size among the Mazatlan specimens, that the peculiar features of the mainland material are of larval derivation. However, the mainland specimens are quite as well developed sexually as are Californian specimens of similar size, and the Panamanian female is by far the largest of the known individuals of *S. mutator*; while at the same time juveniles from Lower California, smaller and less developed sexually than are any from the mainland, display no traces of the extra spines and carinae characteristic of the latter. The

question of the significance of the differences between the Californian and the mainland specimens is a most interesting one, and it is to be regretted that no more satisfactory an account than the above can be offered.

PENAEUS Fabricius.

Penaeus, Burkenroad, 1934a p. 74.

DIVISION 2, Burkenroad, 1934a, p. 75.

***Penaeus californiensis* Holmes.**

Penaeus californiensis, Holmes, 1900, p. 218; Pesta, 1915, p. 113.

Penaeus canaliculatus, Holmes, 1895, p. 581.

Penaeus brevirostris, part, Rathbun, 1902, p. 287; 1904, p. 146; Schmitt, 1921, p. 21; Burkenroad, 1934a, p. 91.

Penaeus brasiliensis, part, Schmitt, 1935, p. 16.

(Text-figures 10, 11, 14, 15).

Range: San Francisco, California; Santa Monica, California; Gulf coast of Lower California; west coast of Mexico near Esquinapa. Beach to 45 fathoms; Juveniles in lagoons and estuaries.

Material: A total of 3 specimens (1 ♂, 2 ♀) was taken on Arena Bank, 45 fathoms (Station 136 D-2, Cat. No. 36,972).

Dimensions and Sexual Condition: Larger female impregnated, of carapace 34 mm., total length about 140 mm.; smaller female of carapace 30 mm., unimpregnated. Male fully adult, carapace length 30 mm.

Remarks: No more than two American species of Section 2 of *Penaeus* have in the past been recognized. The names generally applied to these have been, for Atlantic specimens, *P. brasiliensis* Latreille; for Pacific ones, *P. brevirostris* Kingsley. In the two most recent considerations of the group, Burkenroad (1934a, pp. 91 seq.) has advanced some reasons for believing that Atlantic is specifically distinct from Pacific material, while Schmitt (1935, pp. 16-17) refers all American material to a single name, *P. brasiliensis*.

It now appears, however, that there are no less than five species of Division 2 in the American waters, three Atlantic and two Pacific ones. As the account of the Atlantic forms will appear in a forthcoming paper, it is proposed to describe and to differentiate only the two Pacific species in this place.

Although there seems in the past to have been no suspicion of the existence of more than one species of the *P. brasiliensis* group in Pacific America, names are already available for both of the newly separated forms. Some juvenile specimens from Nicaragua were described by Kingsley, 1878, p. 98, as the new species *Penaeus brevirostris*.³ In 1895, Holmes incorrectly referred specimens of the *brasiliensis* group from Southern California and San Francisco Bay (which he thought likely to be identical with Kingsley's material) to the Indo-Pacific *P. canaliculatus* (Olivier). In 1900 Holmes retrieved this error by describing the Californian specimens as the new species *P. californiensis*; but as he failed at this time to refer to Kingsley's species, his name has subsequently been regarded by most workers as synonymous with *P. brevirostris*. *P. californiensis* Holmes is entered in his list of peneid species by DeMan, 1911, p. 10, but it is intentionally omitted from the account of *Penaeus* by the same author, who according to p. 131 accepts its identity with *P. brevirostris*. Pesta, 1915, p. 113, identifies mate-

³ This name was later incorrectly referred to the synonymy of *P. brasiliensis* by Kingsley himself (1879, p. 427), thus antedating the similar action by Verrill in 1922 and by Schmitt, 1935, p. 17.

rial from San Francisco Bay as *P. californiensis* Holmes, but considers it likely that Kingsley's specimens are juveniles of the same form; he remarks "Es scheint mir jedoch zweckmässiger den *P. californiensis* Holmes, von dem eine gut Diagnose mit abbildungen gegeben ist, bestehen zu lassen, und vielleicht die Spezies Kingsley's als fragliches Synonym hierher zu stellen."

Since I am informed by Dr. F. M. MacFarland of the California Academy of Sciences that the types of *P. californiensis* Holmes were destroyed in the earthquake and fire of 1906, a specimen from Santa Monica, California, is designated below as neotype. The specimen from San Francisco which is figured by Pesta seems to belong to the same species as the neotype. Cotypes of *Penaeus brevirostris* Kingsley, although juvenile, are easily differentiated from the form which occurs in the type locality of *P. californiensis*. Material of the two Pacific American species of the group available to me in addition to that obtained by Dr. Beebe, is listed below. For material credited to the respective institutions, I am deeply indebted to the authorities of the American Museum of Natural History, the Museum of Comparative Zoology, and the U. S. National Museum.

Penaeus californiensis Holmes.

NEOTYPE. U. S. N. M. 23942. Santa Monica, California. 1 ♂ adult, carapace 33 mm.; total length 140 mm.

B. O. C. 18. Concepcion Bay, Lower California; May 3, 1926. *Pawnee II*. 1 ♀ adult, impregnated, carapace length 43 mm.; 8 ♂ adult, carapace 29 to 34 mm.; 3 ♀ juvenile, carapace 14.5 to 20 mm.; 2 ♂ juvenile, carapace 17.5 to 20 mm.

B. O. C. 14. Angeles Bay, Lower California; May 13, 1926; 17-23 fms. *Pawnee II*. 3 ♀ adult (2 impregnated), carapace lengths 31.5 to 38.5 mm.; 2 ♂ adult, carapace lengths 29.5 and 30 mm.

A. M. N. H. 4620 [A]. Lagunaje de las Lomitas, Esquinapa, Sinaloa, Mexico (just south of the Gulf of California); November 15, 1919. Sr. M. Gallegos. 2 ♀ juvenile, carapace lengths 18 mm. and 20 mm.

Penaeus brevirostris Kingsley.

(Text-figures 8, 9, 12, 13).

COTYPES. M. C. Z. Estero at Realejo, Nicaragua; March, 1867. 1 ♀, juvenile, carapace length 13.2 mm.; 1 ♂, juvenile, carapace length 11 mm.

B. O. C. 15. Pearl Islands, Bay of Panama (8° 29' 40" N, 78° 52' 30" W); March 31, 1926. *Pawnee II*. 5 ♀, subadult to juvenile, carapace length 9 mm. to 22 mm.; 2 ♂, juvenile, carapace lengths 10.5 mm. and 11 mm.

B. O. C. 102. Panama City Market (reported locality, Chame River); February 10, 1934. M. D. B. 1 ♀ adult, impregnated, carapace length 38 mm.

B. O. C. 103. Tide-pool, Panama City; February 12, 1934. M. D. B. 1 ♂ juvenile, carapace length 8 mm.

B. O. C. 16. West coast of southern Mexico (14° 48' 40" N, 92° 54' 40" W); April 9, 1926; 30 fms. *Pawnee II*. 3 ♀ adult, impregnated, carapace lengths 46 mm. to 50 mm.

U. S. N. M. 28417. Panama Bay (*Albatross* Station 2795); 33 fms. 1 ♂ adult, carapace 30.5 mm.; 1 ♀ adult, impregnated, carapace 43.5 mm.

U. S. N. M. 28419. Panama Bay (*Albatross* Station 2804); 47 fms. 2 ♂ adult, carapace 31 mm.

A. M. N. H. 4620 [B]. Lagunaje de las Lomitas, Esquinapa, Sinaloa, Mexico; November 15, 1919. Sr. M. Gallegos. 2 ♀, juvenile, carapace lengths 18 mm. and 20 mm.

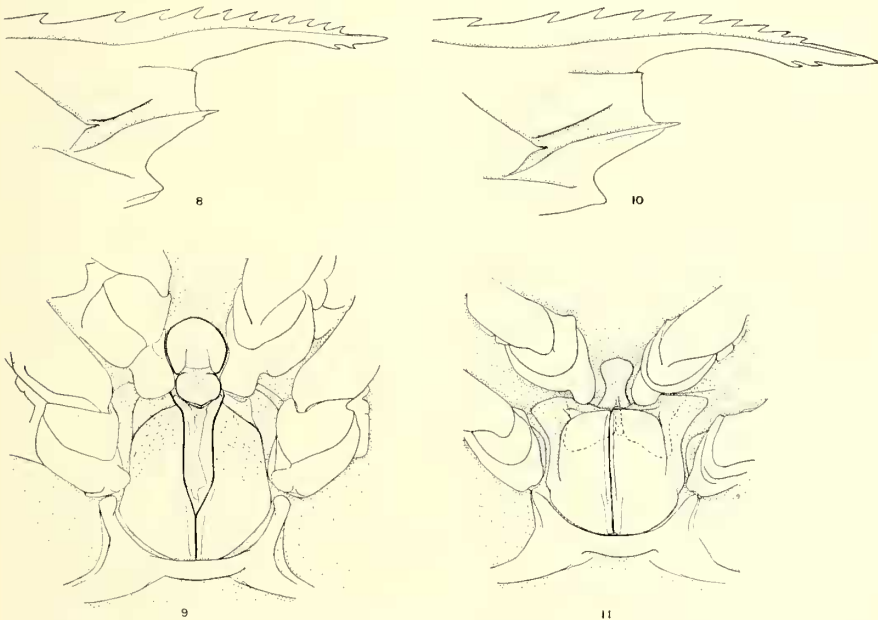
A. M. N. H. 4621. Estero del Puyequé, Esquinapa, Sinaloa, Mexico; November 29, 1919. Sr. M. Gallegos. 1 ♀ juvenile, carapace length 19 mm.; 1 ♂ juvenile, carapace length 17.5 mm.

A. M. N. H. 4622. Pesquería Caligüey, Esquinapa, Sinaloa, Mexico; November 22, 1919. Sr. M. Gallegos. 1 ♂ juvenile, carapace length 19 mm.

A. M. N. H. 4623. Estero del Puyequé, Esquinapa, Sinaloa, Mexico; November 29, 1919. Sr. M. Gallegos. 1 ♀ juvenile, carapace length 15.5 mm.; 2 ♂ juvenile, carapace lengths 18 and 19 mm.

The sharpest non-sexual diagnostic between *P. brevirostris* and *P. californiensis* is supplied by the carina forming the postero-dorsal margin of the antennal sulcus. In *P. californiensis* this carina reaches to within nearly half its length at least of the orbital angle (usually, and in adults almost always, to within one-third); whereas in *P. brevirostris* the carina does not reach to within more than three-fifths its length of the orbital angle, often not within its length.

The orbital angle is more produced and the postorbital carina more pronounced in *P. californiensis* than in *P. brevirostris*; thus in the former the sharply defined posterior part of the crest (best seen in dorsal view) is longer, usually considerably longer, than the more obtuse anterior portion, while in the latter species the anterior obtuse part is usually the longer. The posterior part of the ridge is in *P. brevirostris* often no sharper than is the anterior part in *P. californiensis*, and the anterior part is sometimes hardly discernible.



Text-figures 8-11.

Penaeus brevirostris Kingsley. 8. Carapace (anterior part, lateral view); juvenile ♀ cotype, M. C. Z., x 4. 9. Thelycum; impregnated adult ♀, B. O. C. 102, x 4.

Penaeus californiensis Holmes. 10. Carapace (anterior part, lateral view); juvenile ♀, B. O. C. 18, x 4. 11. Thelycum; unimpregnated adult ♀, D. T. R. 36,972, x 4.

The adrostral carinae of *P. californiensis* are somewhat longer and more widely separated than are those of *P. brevirostris*, generally extending toward the posterior margin of the carapace to within the breadth of the interval separating their posterolateral ends; and are posteriorly better defined than in *P. brevirostris*, being continued medially at the posterior ends of the adrostral sulci. In *P. brevirostris* these carinae usually extend to no more than about three-quarters of the interval between them toward the posterior margin, and are usually not continued medially, so that the adrostral sulci lack a defined posterior margin. These differences in form of adrostral carina are very much less distinct in juveniles than in adults.

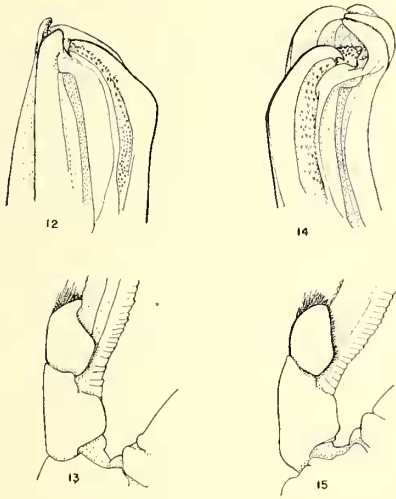
The modal number of dorsal carapacic teeth is different in the two species, as far as the present material serves to indicate, being nine in *P. californiensis*, ten or eleven in *P. brevirostris*. The exact counts are shown in the table:

Number of Rostral Teeth.	Number of Individuals.	
	<i>P. californiensis.</i>	<i>P. brevirostris.</i>
7 + 1 epigastric	1	0
8 + 1	14	2
9 + 1	7	11
10 + 1	1	11
11 + 1	0	1

Finally, the two species seem distinct in thelycum, petasma and appendix masculina. In adult Panamanian females of *P. brevirostris*, the posterior part of the median elevation of the thirteenth sternite forms, in ventral view, a roughly oval or diamond-shaped cup with elevated rim and depressed center, against which the anteromedian lips of the lateral plates of the fourteenth sternite abut, and by which these lips are held apart so that they do not meet in the midline anteriorly. The anterior part of the ventral surface of the lateral plates is quite heavily pubescent. The characteristic form of the median elevation of XIII and the pubescence of the ventral surface of the lateral plates are recognizable in Panamanian juveniles down to a carapace length of 14 mm., though the pubescence cannot be discovered in smaller specimens. Since the lateral plates of XIV gape widely in juveniles of *Penaeus*, the separation of the anteromedian lips of the lateral plates loses its value as a diagnostic in juveniles. In the juvenile female cotype from Nicaragua, of carapace 13.2 mm., the form of the median elevation of XIII is characteristic, but the specimen seems below the size at which the pubescence of the lateral plates appears. In adult females of *P. brevirostris* from southern Mexico, the structure of the thelycum is similar to that in Panamanian specimens, but the anterior parts of the ventral plates are in some individuals only very lightly pubescent. In juvenile females from Esquinapa, of carapace lengths 15-20 mm., the ventral surfaces of the lateral plates are not pubescent at all; and while the posterior part of the median elevation of XIII has the characteristic cup-like form, its posterior end is more extensively produced in a posterior direction, to form an obliquely vertical ridge, than in the Panamanian juveniles.

In adult females of *P. californiensis* from the Gulf of California, the posterior part of the median elevation of XII shows at most no more than a trace of the cup-like form found in *P. brevirostris*; instead, it bears a median longitudinal carina representing an elongation of the posteromedian rim of the cup in *P. brevirostris*. The lateral plates of XIV meet in the

midline for their entire length, their anterior ends thus overlying and concealing the posterior part of the elevation of XIII, as is clearly indicated in Pesta's figure of a female from San Francisco. The lateral plates are not pubescent on their ventral surface. Juveniles of *P. californiensis* maintain the characteristic form of the thelycum (except as regards the meeting of the lips of the lateral plates) down to a carapace length of 18 mm. at least. Although the juveniles of *P. californiensis* are not too readily distinguishable in these features from the Sinaloa juveniles of *P. brevirostris* described above, it is my belief that the Sinaloa juveniles would as adults resemble material from southern Mexico, and would thus, although differing slightly from the Panamanian stock of *P. brevirostris*, fall easily within the same specific limits and be clearly distinct in female genital characters from *P. californiensis*.



Text-figures 12-15.

Peneus brevirostris Kingsley. **12.** Petasma, (distal part, lateral view from right side); adult ♂, U. S. N. M. 28,419, x 5. **13.** Appendix masculina (of right second pleopod, anterior view); as in 12, x 5.

Peneus californiensis Holmes. **14.** Petasma (distal part, lateral view from left side); adult ♂, D. T. R. 36,972, x 5. **15.** Appendix masculina (of right second pleopod, anterior view); as in 14, x 5.

The petasma of adult males of *P. californiensis* displays the following critical characters: The medially curved distal ends (distoventral lobes) of the heavily chitinized lateral ribs of the petasma terminate in a sharply pointed recurved tip which is free from the membranes forming the median parts of the petasma. The distolateral or free margin of the distal ends of the ribs is unarmed; the proximomedian margin which is attached to the membranes forming the median parts of the petasma is most frequently armed on its anterior or dorsal side with a single proximally directed tooth-like spine (the range in armature being from no such teeth to five). Just median to the tip of the lateral rib is a large, fleshy posteriorly projecting flap the area of which is nearly comparable with that of the distomedian lobe. This flap, which probably represents a part of the distolateral lobe, is armed on its free edge with several series of spines like those arming the anterior surface of the membranes median to the lateral rib and those on the median edge of the lateral rib itself. The posteriorly curved distomedian lobes are quite long, and overlap the distal ends of the lateral ribs by a considerable amount. The characteristic features of the adult petasma are well-developed in the two available juvenile males with separated petasmatid endopods.

In adult males of *P. brevirostris* from Panama the petasma differs from that of *P. californiensis* as follows: The medially directed distal ends of the lateral ribs terminate in a blunt tip not projecting free of the median membranes; this tip is armed on its distolateral or free edge with one or two

conspicuous axially-directed teeth which seem not to be homologous with the projecting, recurved, acutely-pointed tip in *P. californiensis*. The proximomedian margin of the anterior, or dorsal side of the distal parts of the lateral ribs bears a row of 8 to 11 spines along its juncture with the membranous median parts of the petasma. The folded distal edge of the median parts, at the point of juncture with the tip of the lateral rib, does not project inward as a conspicuous fleshy flap, and is here unarmed. The distomedian lobes of the petasma are relatively short, and do not much overlap the distal ends of the lateral ribs. In the four juvenile males of *P. brevirostris* from Sinaloa, the disunited petasmal endopods are very much like the above, although there is in all but one tooth visible on the free margin of the tip of the lateral ribs, and although there may be as few as four teeth on the proximomedian margin. Juvenile males from Nicaragua and Panama are too small to display recognizable petasmal characters.

In adult and juvenile males of *P. californiensis*, the external margin of the appendix masculina of the second pair of pleopods is approximately straight. In adult males of *P. brevirostris* from Panama and in juveniles from Sinaloa the external margin of the appendix is deeply concave. In Panamanian and Nicaraguan juveniles, the carapace length of which is less than 10.5 mm., the external margin of the appendix masculina is straight, but this organ, like the petasma, is extremely small and undeveloped in these very small specimens and presumably does not yet display the adult characters.

PENAEOPSIS A. Milne Edwards (Bate).

Penaeopsis, Burkenroad, 1934b, p. 7.

Subgenus METAPENAEOPSIS Bouvier.

Metapenaeopsis, Burkenroad, 1934b, p. 8.

SECTION I, Burkenroad, 1934b, p. 8.

***Penaeopsis (Metapenaeopsis) kishinouyei* (Rathbun).**

Parapenaeus kishinouyei, Rathbun, 1902, p. 288.

Penaeopsis kishinouyei, Schmitt, 1924, p. 161.

Not *Penaeopsis kishinouyei*, Boone, 1930, p. 108; 1931, p. 176.

(Text-figures 16, 17).

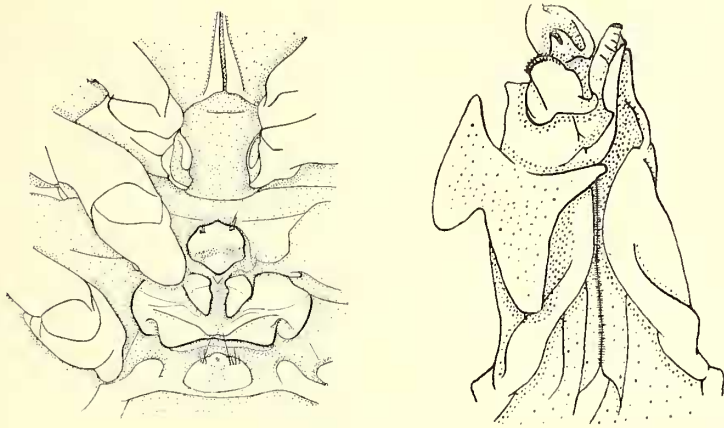
Range: Galápagos Islands; Revillagigedo Islands; 2-55 fathoms.

Material: Two specimens (1 ♂, 1 ♀) were taken 3 miles off Pyramid Rock, Clarion Island, Revillagigedo Islands (Station 163 D-2, Cat. No. 36,973) in 55 fathoms.

Dimensions and Sexual Condition: Female an impregnated adult of carapace 12 mm., total length about 56 mm. Male a subadult with joined petasmal endopods of carapace 5 mm., total length about 27 mm.

Remarks: The present record of *Penaeopsis kishinouyei*, although from a locality nearly 20° to northward of the Galápagos from which the species is otherwise definitely known, and from deeper water, refers like the original record to the neighborhood of an isolated group of oceanic islands. Whether the species occurs on the mainland, from which it has twice been recorded by Boone, is extremely doubtful; thus the Panamanian specimen in the collection of the American Museum of Natural History, referred to *P. kishinouyei* by Boone, 1931, p. 176, is entirely distinct from Rathbun's species and will be discussed in a further paragraph as *P. beebei* sp. nov. (not *P. mineri* Burkenroad, to which closely related form I have erroneously

referred the Panamanian specimen in 1934b, p. 28). As to the Costa Rican specimen referred to *P. kishinouyei* by Boone, 1930, p. 108, according to her Plate 33 the fifth legs of this specimen are nearly as long as the third, the telson lacks conspicuous lateral armature, the antennular flagella are longer than their peduncle, and the exopodites of the walking-legs are swollen and bladder-like; I would therefore infer that it may perhaps belong to another genus than *Metapenaeopsis*. As a possible analogy, mention may be made of figure 4B in the same paper, which although referred to "*Penaeopsis goodei*," obviously represents the petasma of *Trachypeneus*. If the Costa Rican specimen is not a *Metapenaeopsis*, it is necessary to assume that such portions of Boone's description as that (p. 110) referring to the sternal spines characteristic of *Metapenaeopsis* may, like the descrip-



Text-figures 16 & 17.

Penaeopsis kishinouyei (Rathbun). 16. Thelycum; adult ♀, D. T. R. 36,973, x 10.

Penaeopsis kishinouyei (Rathbun). 17. Petasma (posterior view, "dust-cap" bent down to expose distal parts); subadult ♂, D. T. R. 36,973, x 25.

tions of thelycum and petasma in the same account, be drawn from Rathbun's remarks on *P. kishinouyei* rather than from the animal figured on Plate 33. Boone's unrecognizable figure 3A, given as an original drawing of the thelycum of *P. kishinouyei* (although the material which she has examined is stated to have consisted of "one adult male") bears a great resemblance to the similarly unrecognizable figure 4A given by the same author as that of "*Penaeopsis goodei*." It must be admitted that this figure is rather suggestive of *Metapenaeopsis*, by reason of the occurrence of a spine at the anterior end of what seems intended to represent the median plate of XIII; however, it seems unlikely the drawing can refer to *P. kishinouyei*, since at a carapace length of 11 mm. the median plate seems to have lost its armature in that species.

Accepting that *P. kishinouyei* has not yet been taken on the mainland, its limitation to oceanic islands off the Pacific American coast would seem a matter of considerable interest, inasmuch as the mainland would seem as readily accessible to a littoral animal of the Galápagos as would the Revillagigedo Islands.

For comparison with the present Revillagigedo specimens, one of the two juvenile females taken off Indefatigable Island by the Williams Galápagos Expedition, and reported by Schmitt, 1924, p. 161; as well as three

juvenile females (the largest of carapace 5.2, total length about 25 mm.) and a juvenile male (of carapace 4 mm.; petasmas endopods not joined) taken at *Arcturus* Station 54 (Gardiner Bay, Hood Island, Galápagos; April 25, 1925; 15 feet), from the collection of the Department of Tropical Research, have been available.

P. kishinouyei differs from the related American species in that the basis of the second leg is constantly unarmed. Its rostrum also seems to bear a smaller number of teeth than in the other species, the average for the six available specimens being 8 + 1.

The petasma of the juvenile male from the Galápagos displays in recognizable form the peculiarities of the Revillagigedo subadult. The distinctive features of the petasma of *P. kishinouyei* are, that the lateral shoulder of the distolateral lobe of the right endopod bears a short obtuse conical projection; the main or ventral lobule of the distolateral lobe is a blunt cone armed on the dorsal rim of its distal end with a single lunate row of spinules; the dorsal lobule of the distolateral lobe is an undivided projection much smaller than the ventral lobule; the projection or "dust-cover" of the distoventral lobe is distally deeply cleft into a small right and large left lobule, the right partially folded under the left.

The present Revillagigedo female, by far the largest specimen of *P. kishinouyei* so far recorded, agrees with Rathbun's figure 15, Pl. XII, 1902, of the Galápagan type of 33 mm., total length, in that the anterior margin of the median plate of the thelycum is unarmed. As regards certain other features of Rathbun's drawing, particularly the enormous bilobed form indicated to characterize the coxa of the fourth legs, I find no correspondence with available material. Rathbun's figure is incomplete, the posterior part of the fourteenth sternite not being represented. In the available juvenile females from the Galápagos, the thelycum differs from that of the northern adult in that the posterior parts of the median plate are shorter and broader, and the anterior margin armed with a median spine; these differences seem however to be referable to youth. The thelycum of *P. kishinouyei* differs from that of the related Pacific forms (aside from the disappearance of the anteromedian spine in adults, a unique feature) in that the semicircular median elevation of the thirteenth sternite is not posteromedially depressed; and the posterior parts of the median plate of XIII are moderately elongate, little elevated, and taper to their posterior ends. There appears to be a pair of sac-like membranous sperm-receptacles invaginated beneath the lateral hoods of sternite XIV. The transverse plate of XIV is about three or four times as broad as long; its posterior half slopes sharply down to well below the level of the median part of the transverse ridge of the posterior margin of the sternite. The anteromedian edge of the transverse plate does not overhang the posterior parts of XIII or the anteromedian prolongation of XIV.

*Penaeopsis (Metapenaeopsis) beebei*⁴ sp. nov.

(Text-figures 18, 19).

Type: Type and cotypes, Cat. No. 36,983 (4 ♂, 4 ♀), Department of Tropical Research, New York Zoological Society. Taken at Station 136, Dredge 30, Arena Bank, Gulf of California, 23° 27' N. Lat., 109° 24' W. Long., 4-foot dredge, 35 fathoms, May 1, 1936.

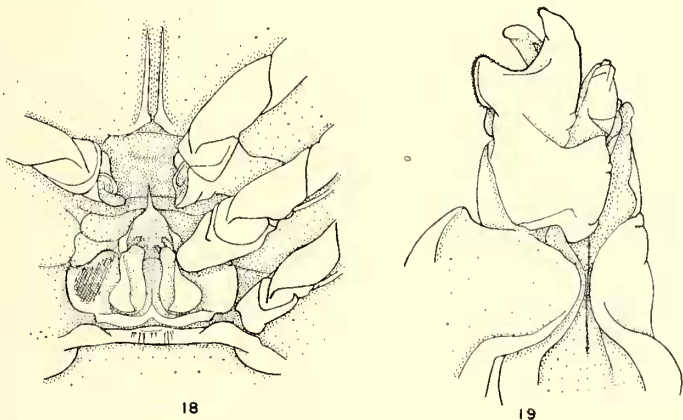
Range: Gulf of Panama; Lower California, 3 to 50 fathoms.

Material: A total of 106 specimens (almost equally divided as to sex) was taken at San Lucas Bay (Station 135) and at Arena Bank (Station

⁴ Named for Dr. William Beebe of the Department of Tropical Research, New York Zoological Society.

136), at the southern end of Lower California, as follows: Station 135: D-1 (4 ♂, 1 ♀), D-9 (20 ♂, 21 ♀), D-11 (9 ♂, 16 ♀), D-20 (1 ♂), D-18, D-19, D-21 to D-25 (4 ♂, 5 ♀), D-26 (1 ♂, 1 ♀); Station 136: D-6 (1 ♂, 1 ♀), D-21 (1 ♂), D-24 (2 ♂, 5 ♀), D-26 (1 ♂); D-27 (2 ♂, 1 ♀), D-30 (4 ♂, 4 ♀). Cat. Nos. 36,974, 36,975, 36,1027, 36,977, 36,978, 36,979, 36,980, 36,981, 36,982, 36,983, 36,1028.

Dimensions and Sexual Condition: Females ranging in carapace length from 13.5 mm. (impregnated adult) to 4.5 mm. (juvenile); total length at carapace 10 mm. about 44 mm.; at 5 mm. about 21 mm. Males ranging in carapace length from 11 mm. (adult) to 4 mm. (juvenile); total length at carapace 9 mm. about 42 mm., at 5 mm. about 23 mm. Petasmas endopods joined and of adult appearance down to a carapace length of 6 mm. Both juveniles and adults are included in all of the more extensive samples, without any indication of segregation as to either locality or depth.



Text-figures 18 & 19.

Penaeopsis beebeyi, n. sp. **18.** Thelycum (position of right sperm-receptacle indicated by cross-hatching); adult ♀ type, D. T. R. 36,983, x 7. **19.** Petasma (posterior view, "dust-cap" bent down to expose distal parts); adult ♂ type, D. T. R. 36,983, x 15.

Diagnosis: Vestigial anterior arthrobranch present on the thirteenth somite. Distoventral projection of the left side of the asymmetrical petasma reduced to a vestige.

Rostrum modally with 9 teeth in addition to the epigastric. The second pleonic tergite lacks any trace of median longitudinal carina; the third is compressed but not sharply carinated. Posterior pair of mobile lateral spines of the telson exceeding by little or nothing the fixed pair succeeding them. Stylocerite less than half as long as the external margin of the basal segment of the antennular peduncle. Basis of second leg usually spinose but sometimes unarmed.

Median elevation of thirteenth sternite of the female with a subtriangular outline, its posteromedian portion much depressed below the anterior and lateral rim; the anteromedian margin armed with an anteriorly directed spine of moderate size. Posterolateral parts of the median plate of XIII tear-shaped in outline, anteromedially depressed, posterolaterally elevated. A pair of membranous sperm-receptacles invaginated to lie internal to the lateral hoods of the fourteenth sternite. Transverse plate near the posterior margin of XIV more than six times as broad as long; the anteromedian margin slightly convex but not produced to overhang the postero-

lateral parts of XIII; the posterior margin depressed below the level of the posterior rim of the sternite.

Lateral shoulder of the distolateral lobe of the right endopod of the petasma a gently curved swelling; main or ventral lobule in ventral view a saddle-shaped transverse elevation crowned with a row of spinules on each of its two peaks, the lateral of the two rows of spinules much more extensive than the median one. Dorsal lobule of the distolateral lobe a subdivided projection nearly as bulky as the ventral lobule but almost entirely concealed behind it in ventral view.

Remarks: *Penaeopsis beebei* very nearly resembles *P. mineri* Burkenroad; and indeed, was confused with the latter by Burkenroad, 1934b, pp. 25-26, since the Panamanian male in the collection of the American Museum of Natural History which was there considered to be a variant individual of *P. mineri* can now be recognized as a representative of *P. beebei*.

P. beebei is distinguishable in non-sexual characters from *P. goodei* (Smith) [and from the African *P. pubescens* (Bouvier)] by its relatively shorter stylocerite and the weaker carination of its pleon; and from *P. pubescens* by the relatively much shorter mobile lateral spines of its telson. It differs from all of the American members of its section in the inconsistency of the armature of the basis of its second leg, which appendage appears to be constantly unarmed in *P. kishinouyei*, constantly armed in *P. mineri* and the two Atlantic American species. In the available material of *P. beebei*, a well-developed spine is present on the basis of the second leg in 78 individuals, a rudimentary one in 8 individuals, and no spine at all in 19 individuals. Although the spine modally diminishes in relative size with decrease in size of the individual, its absolute presence or absence seems to be independent of the size or sex of the individual. Even at its maximum, the spine is smaller in *P. beebei* than in *P. mineri*.

In rostral, as in pereopodal armature, *P. beebei* falls between *P. kishinouyei* and *P. mineri*, as tabularly indicated below.

Number of Rostral Teeth.	Number of Individuals.		
	<i>P. kishinouyei.</i>	<i>P. beebei.</i>	<i>P. mineri.</i>
13 + 1 epigastric	0	0	1
12 + 1	0	0	5
11 + 1	0	0	23
10 + 1	0	4	23
9 + 1	2	63	5
8 + 1	2	22	0
7 + 1	2	0	0

In the 4 individuals of *P. beebei* with ten rostral teeth, and in somewhat more than half of the 63 with nine, the anteriormost tooth is rudimentary. Variations in rostral armature show no conspicuous correlation with size of individual, but the number of teeth tends to be greater in the females. The rostrum of *P. beebei*, as that of other species of the section, varies in length with size of the individual, ranging in extent from the end of the first to the middle of the second segment of the antennular peduncle. As in *P. kishinouyei* and *P. mineri*, the rostrum of *P. beebei* is somewhat deeper proximally than it is in the Atlantic American species.

P. beebei agrees with all of the American species except *P. goodei*

(Smith) in that the females possess a pair of sac-like, membranous sperm-receptacles invaginated from the lateral portions of the groove between the twelfth and thirteenth sternites. The thelycum is very similar to that of *P. mineri* from which it differs as regards the subtriangular rather than semicircular outline of the median elevation of XIII which is armed with a somewhat smaller anteromedian spine (this spine being relatively larger in *P. mineri* than in any of the other American species). The posterior parts of XIII are in *P. beebei* much less narrow, elongate and elevated than in *P. mineri*; the transverse plate of XIV is shorter and its anterior margin much less produced; the thelycum thus appears much less cuplike than in *P. mineri*. The anteromedian margin of the transverse plate of XIV is convex rather than notched as in *P. mineri*.

To an even greater extent than as regards thelycum, the petasma of *P. beebei* resembles that of *P. mineri* much more nearly than that of any other species. The principal differences are that in *P. mineri* the lateral of the two rows of spinules crowning the eminences of the ventral lobule of the distolateral lobe is hardly more extensive than the median row, instead of much more extensive as in *P. beebei*; and the lateral part of the dorsal lobule of the distolateral lobe projects considerably beyond the ventral lobule in ventral view instead of being hidden behind it as in the present species.

***Penaeopsis (Metapenaeopsis) mineri* Burkenroad.**

P. (M.) mineri, Burkenroad, 1934b, p. 25, part.

Range: Lower California, both coasts, 7 to 30 fms.

Material: A total of 61 specimens (the males slightly outnumbering the females) was taken at Magdalena Bay, Pacific coast of Lower California (Station 131), San Lucas Bay on the southern coast (Station 135) and Santa Inez Bay on the Gulf coast (Stations 141 and 142) at depths of 6 to 30 fathoms, as follows: Station 131: D-1 (6 ♂, 10 ♀); Station 135: D-11, D-12 (2 ♂); Station 141: D-1 (3 ♂), D-4 (2 ♂, 5 ♀); Station 142: D-1 (23 ♂, 10 ♀). Cat. Nos. 36,984, 36,985, 36,986, 36,987, 36,988.

Dimensions and Sexual Condition: Females ranging in carapace length from 11.5 mm. (impregnated adult) to 5 mm. (juvenile); males from 11 to 5 mm. The petasmal endopods are already joined distally in the smallest specimen available, but are of fully adult condition only above 6 mm. No particular indication of local segregation as to size or sex is discernible.

Remarks: Although *P. mineri* has so far been recorded only from Lower California, the fact that there is but one specifically determinable record of the genus from the Pacific American mainland south of 22° N. permits no speculation as to the actual range of the species. It is perhaps interesting that although their ranges overlap, *P. mineri* was taken in company with *P. beebei* only once, at Station 135, and then in very small number.

The present extensive material requires modification of the original description in certain particulars. The rostral armature varies from 9 + 1 to 13 + 1, the modal number being 10 or 11 teeth in addition to the epigastric; the extremes are infrequently found. Recognition of the "variant" Panamanian male erroneously referred to the present species in 1934b (p. 26) as representing the closely related but distinct species *P. beebei* disposes of the opinion previously held that the basal spine of the second leg in *P. mineri* is variable in occurrence. The distoventral projection of pars externa of the right petasmal endopod is not, as described in 1934b (p. 28), shallowly cleft into "a small right and a large left lobe," but into two subequal lobes the left of which partially conceals the right in ventral view; the essential distinction between the projection in *P. mineri* and in *P. kishinouyei* is therefore that in the latter the left lobule is actually as

well as apparently considerably larger than the right. Rathbun's statement that the "left half" of the "petasma" of *P. kishinouyei* is longer than the right evidently refers to the distoventral projection of pars externa of the right endopod only; and not, as interpreted in 1934b (p. 28) to the actual halves of the petasma, the two endopods.

In the comparison of the thelycum of *P. mineri* with that of the Atlantic American species of *Metapenaeopsis*, given in 1934b, the statement is made (p. 28) that the transverse groove between sternites XIII and XIV is in *P. mineri* "anteromedially so shallow . . . that it is probably no more than a vestige bereft of the sperm-storing function which this portion of the groove possesses in *P. goodei* and *P. smithi*;" and I have also stated (p. 10) that "in the American species of *Metapenaeopsis*, no portion of this depression [the transverse groove] is especially expanded; the spermatophores enter each lateral half of the groove by median openings, the sperm being extruded at the lateral, anterior ends of the groove." These statements are not entirely correct, and a more precise description of sperm-storage in these forms is therefore offered here, as follows:

In *P. goodei* (as described in 1934b, p. 18), the transverse groove is on either side quite deep in its entire length, and the spermatophore is introduced into the elongate, U-shaped receptacle of either side at its antero-median end, on the *inner* side of the posterior part of the median plate. The median limb of the U is occupied by an elongate cylinder of sperm-free material; while the sperm lie near the exit of the receptacle, at the anterolateral end of the U, which is not particularly expanded for this function. In *P. smithi*, on the contrary, the part of the transverse groove homologous with the median limb of the U in *P. goodei* is shallow, and is not employed in spermatophore storage; and the entrances of the receptacles seem to lie near the posterior ends of the lateral limbs of the transverse groove, on the *outer* sides of the posterior parts of the median plate; instead of on the inner sides of the posterior parts at the anterior ends of the median limbs of the transverse groove, as in *P. goodei*. Further, the anterior ends of the lateral limbs of the transverse groove in *P. smithi*, near the exits, are quite definitely expanded as membranous sacs into which the sperm-bearing portion of the spermatophores is introduced; the sperm-free secretion of the spermatophore seems much reduced in quantity as compared with *P. goodei*, commensurate with the reduction of that part of the groove in which the secretion might be stored. The receptacular arrangements in the three Pacific American species of the subgenus are very similar to those of *P. (M.) smithi*, although there is little resemblance in superficial sculpture. It therefore appears that as regards the method of sperm storage, *P. goodei* is unique among its American congeners; and it seems possible that *P. mineri*, *P. beebei*, and *P. kishinouyei* are more closely related to *P. smithi* than to *P. goodei* and *P. pubescens* (to which *P. kishinouyei* displays some superficial resemblance in sculpture of the thelycum). It is probable, however, that the three Pacific species are more closely related to one another than they are to any of the Atlantic forms.

TRACHYPENEUS Alcock.

Subgenus TRACHYSALAMBRIA Burkenroad, 1934b, p. 49.

SECTION 1, Burkenroad, 1934a, p. 94.

Trachypeneus similis pacificus Burkenroad.

T. (T.) s. pacificus, Burkenroad, 1934b, p. 50.

Range: Gulf of Panama; Lower California, both coasts; 12-24 fms.

Material: Five specimens (1 ♂, 4 ♀) were taken at Magdalena Bay,

Pacific coast of Lower California, in 12 fathoms, March 29, 1936. (Station 131 D-1, Cat. No. 361,026).

Dimensions and Sexual Condition: Females ranging in carapace length from 8 to 12 mm.; male 7.5 mm. Juvenile.

Remarks: In the adults of *T. s. pacificus* the anterior margins of the produced posterior lips of the transverse groove are conspicuously truncated, as stated in the original description. In the juveniles, however, this truncation is hardly discoverable, the anterior margins of the lips being roundedly convex somewhat as in the Atlantic American species *T. constrictus* (Stimpson). In the Atlantic American *T. s. similis* (Smith) the truncation develops with age as in *T. s. pacificus*, but the lips are never so decidedly convex as they are in the juveniles of the Pacific subspecies. Other diagnostic differences between *T. similis* and *T. constrictus*, listed in 1934b, are little affected by growth in subadult stages.

SECTION 2, Burkenroad, 1934a, p. 94.

***Trachypeneus (Trachysalambria) brevisuturæ* Burkenroad.**

T. (T.) brevisuturæ, Burkenroad, 1934b, p. 55.

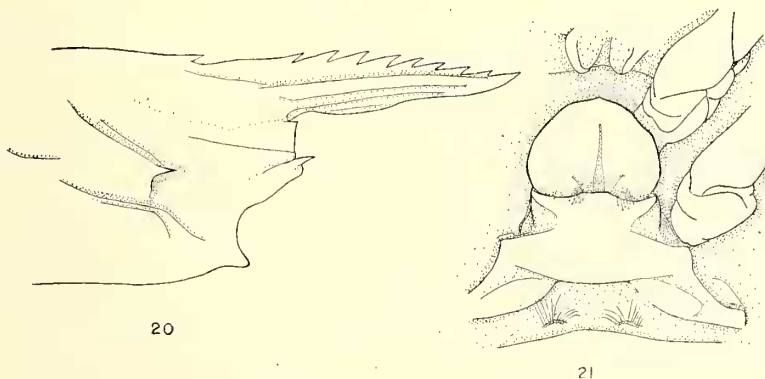
(Text-figures 20, 21).

Range: El Salvador; Lower California; 3-35 fms.

Material: A total of seven specimens (of which two are males) was taken at San Lucas Bay (Station 135) and at Arena Bank at the southern end of Lower California (Station 136) in 3 to 35 fathoms, as follows: Station 135: D-1 (1 ♂, 3 ♀), D-6 (1 ♂), D-18 (1 ♀); Station 136: D-30 (1 ♀). Cat. Nos. 36,989, 36,990, 36,991, 36,992.

Dimensions and Sexual Condition: Females ranging from carapace length 15 mm., total about 58 mm. (impregnated adult) to carapace length 5 mm. (juvenile). Both males of carapace length 7 mm. (subadults with joined petasmasl endopods).

Remarks: The present Californian material seems in close agreement with the Salvadorean holotype of the species, a subadult male of carapace length 6.5 mm. There is very little difference in non-genital features between adults and juveniles or males and females; except that in the larger



Text-figures 20 & 21.

Trachypeneus brevisuturæ MDB. 20. Carapace (anterior part, lateral view); adult ♀, D. T. R. 36,991, x 5.5. 21. Thelycum; as in 20, x 12.

specimens the rostrum is somewhat longer than in the holotype, reaching as far as to the middle of the second segment of the antennular peduncle. In 4 of the present specimens there are seven rostral teeth in addition to the epigastric; in 3, eight. The branchiostegal carina is very shallow, but quite perceptible; it is obsolescent, rather than "obsolete" as stated in the original description.

Confirming the allocation of *Trachysalambria brevisuturæ* to Section 2 of the subgenus, the thelycum resembles that of the other, Indo-Pacific, species included in the Section, in that the posteromedian lip of the transverse groove is not produced forward as a pair of flaps divided by a deep incision in the manner diagnostic of Section 1. The posterior lip of the transverse groove of the present species, although it is continuous across the midline in the fashion diagnostic of the subgenus, overhangs a median cavity much shallower even than that in the other species of the Section. The thelycum is superficially distinguishable from that of *T. curvirostris* and its allies in that the posterior lip of the transverse groove is in adults (but not in juveniles) medially convex, rather than concave; and in that the portion of sternite XIV lying behind the level of the bases of the fifth legs is longer than the anterior part, rather than shorter. The heart-shaped median plate, which is considerably depressed in the midline, especially posteriorly, bears an anteromedian spine reminiscent of that in *Metapenaeopsis* in the three juvenile females of *D. T. R.* 36989.

EUSICYONIA Stebbing.

DIVISION I, Burkenroad, 1934b, p. 71.

Eusicyonia disparri Burkenroad.

E. disparri, Burkenroad, 1934b, p. 83.

(Text-figures 22, 23).

Range: Southern and Gulf coasts of Lower California, beach⁵ to 35 fathoms.

Material: A total of 3 specimens (2 ♂, 1 ♀) was taken at Arena Bank (Station 136) and at Santa Inez Bay (Station 142) in 30 to 35 fathoms, as follows: Station 136: D-30 (1 ♂); Station 142: D-1 (1 ♂, 1 ♀). Cat. Nos. 36,993, 36,994.

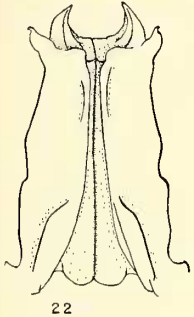
Dimensions and Sexual Condition: Female of carapace length 7 mm., total about 29 mm. Larger male of carapace length 6.9 mm.; smaller of carapace 4 mm., total length 15.5 mm. The petasma of both males is of adult form.

Remarks: The female of the present collection is in detailed agreement with the types. The larger male, taken in the same catch as the female, agrees well as to sculpture and armature of carapace and pleon, except that the posteriormost rostral tooth is somewhat farther in advance of the orbital margin than in material previously recorded. The small male (*D. T. R.* 36993) differs quite considerably from other known specimens of *E. disparri*, which are all of considerably larger size, in that the rostral tip bears only four teeth, the third rostral tooth is not a great deal farther behind the tip than it may be in *E. laevigata* (Stimpson), the first or posteriormost rostral tooth is not a great deal closer to the orbit than it sometimes is in *E. laevigata* (Stimpson), the anterior postrostral tooth is conspicuously smaller than the two following ones (although it is relatively much larger than even the extreme in *E. laevigata*), and finally, the anterior three pleonic somites bear a trace of posterior pleural sulcus, much shorter and

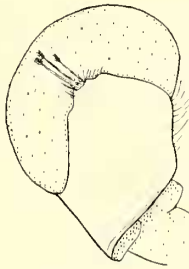
⁵ "Beach" record based on specimens taken in the seine by the *Pawnee*, at depths presumably not greater than 5 fathoms.

shallower than in *E. parri* Burkenroad, but quite definite; and the anterior tergal of the fourth somite is continuous, as in *E. carinata* (Olivi), not interrupted as in *E. laevigata*, *E. parri*, and the other available specimens of *E. disparri*. In spite of these differences from the specific norm it seems to me safest for the present to identify *D. T. R.* 36993 with *E. disparri*.

The petasma of *E. disparri*, which has not previously been described, very nearly resembles that of *E. laevigata*; the distolateral projections are however turned conspicuously inward, somewhat as in *E. carinata*, instead of extending straight distally in ventral view as in *E. laevigata*. A male of *E. parri* taken by Dr. Beebe in Bermuda (which agrees very well in non-sexual characters with the female holotype from the Bahamas) resembles the present males of *E. disparri* in form of sexual appendage, except that the proximal border of the notch in the lateral margins of the petasma protrudes beyond the margin proximal to it as a prominent shoulder.



22



23

Text-figures 22 & 23.

Eusicyonia disparri MDB. 22. Petasma (posterior view); adult ♂, *D. T. R.* 36,994, x 14. 23. Eye (of left side, dorsal view); adult ♀, *D. T. R.* 36,994, x 14.

Since the variant small male referred with some doubt to *E. disparri* above softens several of the differences previously given as distinguishing this species from related forms, especially *E. parri*, certain additional distinctions between the Atlantic and the Pacific forms may be considered.

In all five of the available specimens of *E. disparri* the middle part of the posterior margin of the pleura of the fourth pleonic segment is decidedly concave and is ventrally set off by a well-developed angle which in the largest specimens is acute. In both specimens of *E. parri* (as in *E. laevigata* and *E. carinata*), the midsection of the posterior margin of the fourth pleura is straight and the posterior rounds into the ventral margin without a defined angle. In the five specimens of *E. disparri* the ventral margins of the rostrum, near its distal end, bear one or two small but conspicuous mobile spinules on either side, which are absent in both specimens of *E. parri*. In four of the five specimens of *E. disparri* the rostrum bears a fourth tooth on its dorsal margin just behind the tip, which is not present in either example of *E. parri*.

The first of the above characters may perhaps be subject to variation; the second probably is (inasmuch as in a male and a female of *E. laevigata* from the west coast of Florida the mobile rostral tooth [similar to those of *E. disparri*] present in all fourteen members of the species previously examined by me, is absent); and the third is certainly variable; these differences therefore appear not to be diagnostic. A diagnostic between *E. parri* and *E. disparri* seems however to be provided by size and shape of eye. In the Atlantic form the distal, cornea-bearing section of the ocular peduncle is relatively longer and is much less expanded at its distal end; and the cornea is smaller and is set more transversely than in the Pacific material. The difference in peduncular proportions may be expressed by the ratio of the length of the outer margin of the peduncle to that of the carapace and

to the breadth of the peduncle across its dorsal surface at base of cornea, as follows:

Species.	<i>Eusicyonia parri.</i>		<i>Eusicyonia disparri.</i>				
	♀	♂	♂	♂	♀	♀	♀
Carapace length in mm.	6.3	8.0	4.0	6.9	7.0	9.2	9.3
Ratio of length of outer margin of distal part of ocular peduncle to carapace length.	.14	.13	.10	.11	.11	.09	.09
Ratio of length to breadth of ocular peduncle.	.83	.76	.58	.52	.53	.52	.53

DIVISION II, Burkenroad, 1934b, p. 73.

Eusicyonia disedwardsi Burkenroad.

E. disedwardsi, Burkenroad, 1934b, p. 86.

Range: Lower California, Gulf coast and southern tip; 6 to 50 fathoms.

Material: A total of 33 specimens (about half of them males) was taken at San Lucas Bay (Station 135), Arena Bank (Station 136) and Santa Inez Bay (Stations 141, 142, 143) in 6 to 50 fathoms, as follows: Station 135: D-1 (3 ♂, 1 ♀), D-9, D-10 (1 ♀), D-26 (1 ♀); Station 136: D-1 (1 ♀), D-6 (2 ♂), D-24 (2 ♂, 2 ♀), D-30 (4 ♂, 2 ♀); Station 141: D-1 (1 ♀), D-3 (1 ♂, 1 ♀), D-4 (3 ♂, 1 ♀); Station 142: D-1 (2 ♂, 3 ♀), Station 143: D-1 (1 ♀). Cat. Nos. 36,995, 36,996, 36,997, 36,998, 36,999, 361,000, 361,001, 361,002, 361,003, 361,004, 361,005, 361,006.

Dimensions and Sexual Condition: Females ranging in carapace length from 16.2 mm. to 7 mm.; males from 15.3 mm. to 4.6 mm. Total length of the largest male, about 59 mm. The haul from Station 136, D-24, composed of the four largest specimens, is the deepest one yielding material of the species; but although the smaller specimens are often those from the least depths, the correspondence is by no means complete. The size of the males at maturity seems quite irregular; there are specimens with unjoined petasmal endopods ranging in carapace length from 6.8 mm. to 8 mm., and specimens with the endopods hooked together at the distal end only ranging in carapace length from 5.5 mm. to 10 mm.

Remarks: *Eusicyonia disedwardsi* was described with some misgivings from a single subadult male; and it is therefore with considerable satisfaction that a confirmation of its right to specific distinction is now offered on the basis of an ample material.

Petasma, male genital sternites, and thelycum are practically identical with those of *E. edwardsi*, except that the tips of the distolateral projections of the petasma are often directed rather conspicuously away from the midline instead of parallel to it. Differences from *E. penicillata* in petasma, previously described, are completely constant in adults and are recognizable even in very juvenile stages. Differences in male genital sternite and in thelycum between *E. disedwardsi* and *E. penicillata*, identical with those between the latter and *E. edwardsi*, are constant in adults but are somewhat obscure in very juvenile individuals. The divergence of the tips of the stylets of the ocular somite, constant at all sizes, provides a clear though minute distinction from *E. penicillata*.

Differences in pleonic sculpture from *E. edwardsi* are constant and diagnostic; although the traces of posterior pleural sulcus are often stronger than in the holotype, there is generally a faint trace of posterior tergal on the first somite, and the dorsal end of the posteromedian pleural often reaches the anterior margin as a groove which although shallower than in *E. edwardsi* and *E. penicillata* is not completely obliterated. In large adults the pleura of the fourth somite often bear a posterior ventral tooth or angle.

The rostrum is almost constantly longer than the maximum in *E. penicillata*, and is usually more elevated than in the related Pacific form. As a very obvious distinction from both *E. edwardsi* and *E. penicillata*, it may be observed that the rostrum of every available individual of *E. disedwardsi* bears two teeth behind the bifurcated tip (in addition to the "anterior tooth of the carapace" which is occasionally placed in advance of the orbital margin); whereas in the two related species not more than one individual in ten bears more than one rostral tooth behind the tip.

It may be noted that in one specimen of *E. disedwardsi* the middle tooth of the carapace, in contrast to its usual position, lies anterior to the level of the hepatic spine.

Like *E. penicillata* and several other Pacific species less closely related, *E. disedwardsi* is marked with a large and conspicuous ring or ocella of pigment on the branchial region which seems, peculiarly enough, to be absent in *E. edwardsi* and in the other Atlantic members of the genus.

***Eusicyonia penicillata* (Lockington).**

Sicyonia penicillata, Lockington, 1879, p. 164; Pesta, 1915, p. 118.

Eusicyonia penicillata, Burkenroad, 1934b, p. 88.

Range: Lower California, both coasts; beach to 40 fathoms.

Material: A total of 37 specimens (somewhat more than half of these being males) was taken at Santa Inez Bay (Station 144), at San Lucas Bay (Station 135), east of Cedros Island (Station 126), and at Magdalena Bay, in 2 feet to 40 fathoms, as follows: Magdalena Bay, "In 2 to 3 feet of water under stone" (17 ♂, 14 ♀); Station 126: D-3 (3 ♂, 1 ♀); Station 135: D-11, D-12, (1 ♂); Station 144: D-7 (1 ♀). Cat. Nos. 361,007, 361,008, 361,009, 361,010.

Dimensions and Sexual Condition: Material from Station 126 (a female of carapace length 18 mm. and males of 12.4 to 16.5 mm.), falls within the range of sizes previously recorded (1934b, p. 88) and is fully adult; while the male from Station 135, of carapace length 9.6 mm., although of smaller size, appears to be adult. The series from very shallow water in Magdalena Bay is however composed exclusively of juveniles, the first which I have been able to examine. Females of this series range from carapace length 12 mm. down to carapace 4 mm., total length 17.5 mm.; and males from carapace 8 mm. to carapace 4.9 mm., total length 18.5 mm. The single female from Station 144 is also a juvenile, of carapace length 6.9 mm.

Remarks: The present seem to be the first records of the species from outside the Gulf of California.

In my previous account of *E. penicillata*, I have unfortunately overlooked the description by Pesta, 1915. It may be noted that the otherwise excellent figure 7 of the petasma, there given, is inaccurate in one detail, in that the accessory filaments originate near the middle of the distolateral projections, rather than, as shown, at their bases.

The present juveniles of *E. penicillata* display little change from adult form in non-sexual characters, except that as in many related species the sharp angle terminating the hinder end of the dorsal carina of the fifth pleonic somite becomes more rounded with diminishing size until in the

smallest individuals there is no trace of it. The notch in the posterior margin of the thirteenth sternite loses its narrow subrectangular outline in the juveniles and becomes a shallow concavity; and the ridge across the posterior margin of the thirteenth sternite of the male loses its well-bowed appearance, chiefly by the reduction in relative size and the increased separation of the lateral protuberances.

In males of carapace length 7.5 to 8 mm. the petasmata are hooked together only at their anterior ends, and the filaments of the various projections are relatively shorter than in the adult. Below 7.5 mm. the endopods are unattached, but the adult characteristics of the petasma are recognizably indicated even in the smallest individuals, where the accessory filament is represented by a well-defined shoulder about one-third from the tip of the curtailed but very slender distolateral projection.

***Eusicyonia aliaffinis* Burkenroad.**

Eusicyonia aliaffinis, Burkenroad, 1934b, p. 92.

(Text-figures 25, 27).

Range: Pacific coast of Mexico; southern tip of Lower California; 13 to 30 fathoms.

Material: One male was taken at San Lucas Bay in 13 fathoms (Station 135 D-26, Cat. No. 361,011).

Dimensions and Sexual Condition: The specimen, of carapace length 8.4 mm., is smaller than the holotype, but its petasma is fully developed and of adult form, rather than disunited and juvenile as in the type.

Remarks: The present male agrees precisely in critical non-sexual characters with the Mexican holotype. The petasma shows no very striking differences from that of *E. affinis*, except in the non-projection of a small cusp near the median base of the distolateral projections which is conspicuous in an available large type male of Faxon's species.

In addition to the large specimens of *E. affinis* contained in the collection of the Museum of Comparative Zoology, a comparison of which with *E. aliaffinis* has been presented in my previous discussion of that species (1934b), I have recently been enabled by the kindness of Dr. W. L. Schmitt of the U. S. National Museum to examine the juvenile male of *E. affinis* (U. S. N. M. 21169) which Faxon, 1895, p. 179, records from *Albatross* St. 3369, off Cocos Island, in 52 fathoms. This specimen (figure 24), of carapace 8.8 mm., total length 35 mm., is of the same size as the holotype of *E. aliaffinis*. The agreement of this specimen in all critical characters with the much larger individuals of *E. affinis* previously examined, and its sharp contrast with *E. aliaffinis*, seems to provide justification for my dismissal in 1934b, p. 94, of the possibility that *E. aliaffinis* might "represent a developmental stage of *E. affinis*." The possibility that *E. aliaffinis* and *E. affinis* may represent extremes of variation connected by intergrading forms is discussed in the next paragraph.

***Eusicyonia* species.**

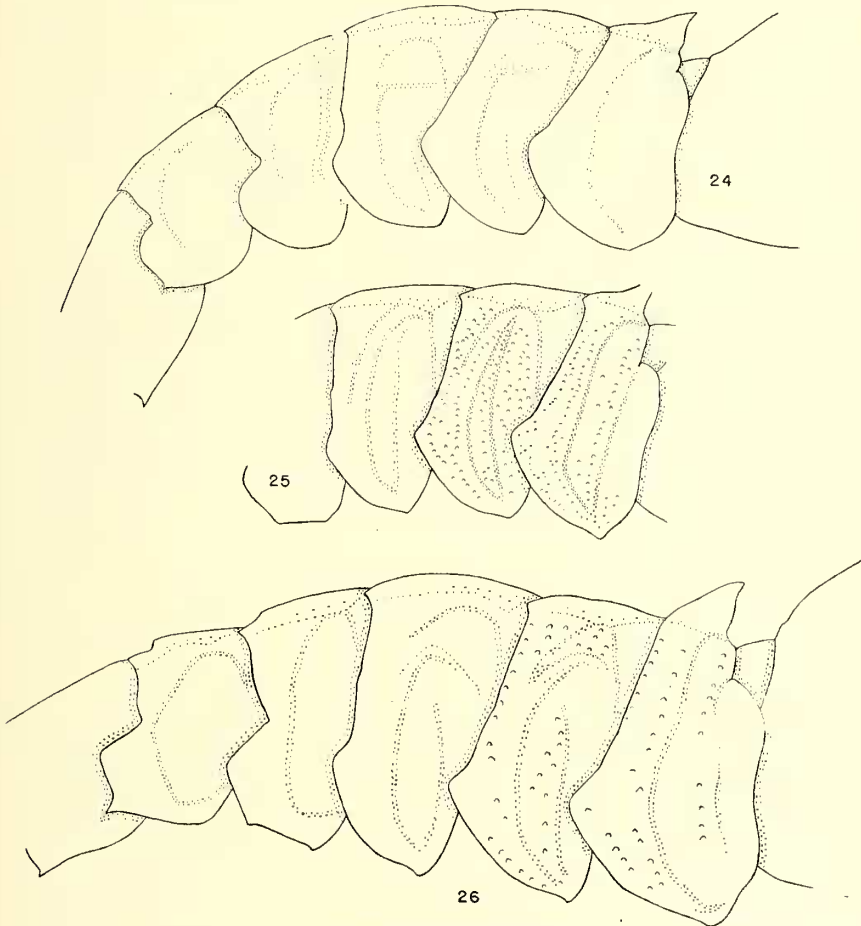
(Text-figures 26, 28, 29, 30).

Range: Known only from Arena Bank at the southern tip of Lower California; 45-50 fathoms.

Material: Two specimens (1 ♂, 1 ♀) were taken at Arena Bank at depths of 45 to 50 fathoms, as follows: Station 136: D-13 (1 ♂), D-24 (1 ♀). Cat. Nos. 361,012, 361,013.

Dimensions and Sexual Condition: The male from Station 136 has a carapace length of 12 mm., total length about 60 mm. The carapace length of the female is 12 mm. Both specimens appear to be fully adult.

Remarks: The present material, representing a species closely related to if distinct from *E. aliaffinis* Burkenroad, agrees with the two known specimens of the latter and differs markedly from *E. affinis* Faxon (figure 24 above) as regards the sharp definition of the angle terminating the dorsal carina of the fifth pleonic somite; the angular outline of the ventral margins of the pleonic pleura (especially those of the fourth somite, the posterior ventral angle of which is in the male even spiniform; and of the first somite, the anteroventral margin of which is in all decidedly concave rather than conspicuously convex as in *E. affinis*); and the coarse tubercula-



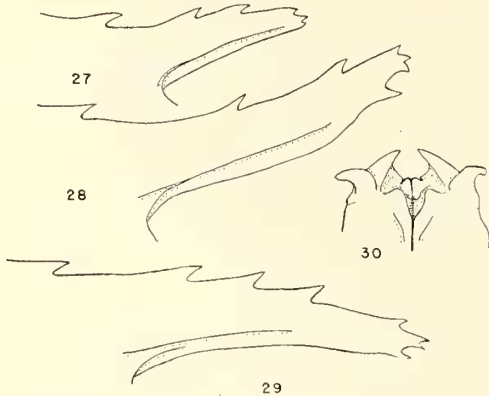
Text-figures 24-26.

Eusicyonia affinis (Faxon). 24. Pleon (lateral view); juvenile ♂, U. S. N. M. 21,169, x 5.5.

Eusicyonia aliaffinis MDB. 25. Pleon (lateral view of anterior part, tubercles indicated for first two somites only); subadult ♂, D. T. R. 361,011, x 5.5.

Eusicyonia species. 26. Pleon (lateral view, tubercles indicated for first two somites only); adult ♀, D. T. R. 361,013, x 5.5

tion of the pleonic surface. On the other hand, however, the two specimens from Station 136 differ considerably from *E. aliaffinis* and approach *E. affinis* in that the posteromedian pleural sulci of the second and third pleonic somites extend dorsally only to within a third of the height of the somite from the dorsal midline (instead of to within a fourth or nearer), turn anteriorly at their dorsal ends, and are margined above by a conspicuous longitudinal ridge.



Text-figures 27-30.

Eusicyonia aliaffinis MDB. 27. Rostrum (lateral view); as in 25, x 6.

Eusicyonia species. 28. Rostrum (lateral view); as in 26, x 6. 29. Rostrum (lateral view); adult ♂, D. T. R. 361,012, x 6. 30. Petasma (distal part, posterior view); as in 29, x 13.5.

The anteromedian pleural sulci of the first, second and third pleonic somites of the two specimens from Station 136 seem to fall about midway in length and definition between those of *E. affinis* and *E. aliaffinis*. The rostrum seems longer than that of either *E. affinis* or *E. aliaffinis*, being approximately half instead of two-fifths or less as long as the carapace and extending far beyond the eyes; and it bears six teeth instead of five in both specimens. While, however, the rostrum of the male from Station 136 is recurved nearly to the horizontal and the third tooth of the dorsal margin lies far behind the trifurcate tip, that of the female is recurved to an angle of elevation much greater even than in the two available specimens of *E. aliaffinis*, the third dorsal tooth forms part of a trifurcate tip, and the sixth tooth is placed on the ventral margin more than half as far from the tip as the penultimate dorsal tooth; the rostrum of the female thus superficially somewhat resembles that of *E. carinata* (Olivi). The transverse ridge at the posterior margin of the fourteenth sternite of the male from Station 136 resembles that of *E. aliaffinis* as regards its dimensions, but is strongly arched. The petasma differs slightly both from that of *E. aliaffinis* and that of the available large male *E. affinis*, in that the distolateral projections are quite convergent; and in that the small cusp near the median base of the distolateral projections is more conspicuous than in *E. aliaffinis*, less so than in *E. affinis*.

Whether the present material should be regarded as a distinct species, as a variant form of *E. aliaffinis*, or as an intergrade between *E. aliaffinis* and *E. affinis* seems difficult of decision. The fact that the pleonic sculpture is the same in *E. affinis* of both large and small size, which is in harmony with what is known of other members of the genus, suggests that differences between the various available groups of individuals of the *E. affinis* superspecies are at least not the correlates of differences in size. The provenance of the present material seems to rule out local variation as an explanation of its attributes. However, the total number of available individuals of the superspecies is not yet sufficient to exclude the possibility that differences between groups of these individuals are referable simply to individual variation (and it may be noted that if the small specimen discussed on

p. 80 actually refers to *E. disparri*, its pleonic characters imply that considerable departure from the specific norm may sometimes occur in species of the genus). Although it seems to me possible that the present specimens represent a third species distinct from both *E. affinis* and *E. aliaffinis*, their systematic status may be left undefined until further material has become available.

***Eusicyonia picta* (Faxon).**

Sicyonia picta, Faxon, 1893, p. 210.

Eusicyonia picta, Burkenroad, 1934b, p. 95.

Range: Off Mariato Point and in the Gulf of Panama, 127 to 182 fathoms; southern and Gulf coasts, Lower California, beach⁶ to 60 fathoms.

Material: A total of six specimens (including 1 male) was taken at Arena Bank (Station 136) and at Santa Inez Bay (Station 147) in depths of 30 to 45 fathoms; as follows: Station 136: D-11 (1 ♀), D-12 (1 ♀), D-15 (1 ♀); Station 147: (1♂, 2 ♀). Cat. Nos. 361,014, 361,029, 361,016.

Dimensions and Sexual Condition: Females ranging in length from carapace 14 mm., total 56 mm., to carapace 8 mm. Male of carapace length 7.5 mm. The largest female is considerably smaller than Faxon's type-specimen of 70 mm. The petasma of the male is of adult form.

Remarks: The rostral armature varies in the present material from three dorsal and two terminal to four dorsal and three terminal teeth. The spacing and position of the dorsal rostral teeth, and the length, elevation and curvature of the rostral blade are quite variable. Although Californian material of *E. picta* has not been directly compared with the Panamanian types, there seems little reason to doubt its identity with the latter.

A direct comparison of *E. picta* with two females and a male, paratypes of *E. stimpsoni* (Bouvier), from Blake Station 293, Barbados, 82 fms., which were very kindly loaned by Dr. F. A. Chace, Jr., of the Museum of Comparative Zoology, confirms the suggestions previously made (Burkenroad, 1934b, p. 96) as to characters distinguishing the two species. In addition to the conspicuously greater breadth and depth of its carapace and pleon, its longer rostrum with ventral tooth very distinctly separated from the two dorsal elements of the tip, and the deeper sculpture of its pleon, *E. stimpsoni* seems to differ from *E. picta* as follows: Its pleon is tuberculate, not punctate only as in *E. picta*. The lateral ridge of its rostrum is usually concave dorsally, so that the ridge is closer and more nearly parallel to the ventral margin of the rostrum than in *E. picta* where the ridge is usually concave ventrally. Its eye and the peduncle of its antenna seem somewhat smaller and shorter and its stylocerite longer. The distolateral projections of its petasma are curved much more to median than is usual in *E. picta*. Finally, whereas in a male of *E. picta* of carapace 11 mm. (*B. O. C. No. 81*) the petasma is 2.9 mm. long by 1.3 mm. broad, and in the present male of *E. picta* of carapace 7.5 mm. the petasma measures 1.3 x 0.7 mm., in the available male of *E. stimpsoni*, of carapace 7.0 mm., the petasma measures 2.5 x 1.2 mm., a size relatively much greater than in *E. picta*.

***Eusicyonia disdorsalis* Burkenroad.**

E. disdorsalis, Burkenroad, 1934b, p. 96.

Range: Gulf of Panama, southern tip of Lower California, 3 to 24 fathoms.

⁶ "Beach" record based on specimen taken in the seine by the *Pawnee*, at a depth presumably not greater than 5 fathoms.

Material: A total of 10 specimens (of which about half are males) was taken at San Lucas Bay (Station 135) in 3 to 20 fathoms, as follows: Station 135: D-11, D-12 (2 ♂, 4 ♀), D-18, D-19 (2 ♂), D-20 (2 ♀). Cat. Nos. 361,017, 361,018, 361,019.

Dimensions and Sexual Condition: All of the specimens are of very small size, the females ranging in carapace length from 6 mm. to 8 mm., the males from 5 mm. to 7 mm. The petasma is, however, of adult form and condition in all of the males, which are presumably adult.

Remarks: No distinction between the present material and that previously known, from the Gulf of Panama, is apparent.

Eusicyonia ingentis, sp. nov.

(Text-figures 31-34).

Type: Type and Cotypes, Cat. No. 361,025, Department of Tropical Research, New York Zoological Society (6 ♂, 4 ♀). Station 127, Dredge 1, off east coast of Cedros Island, west coast of Lower California, 28° 05' N. Lat., 115° 09' W. Long. 4-foot dredge, 38 fathoms, March 27, 1936.

Range: Known only from the present records, from east of Cedros Island on the Pacific coast of Lower California, in 38 to 60 fathoms.

Material: A total of 63 specimens (of which number about three-fifths are males) was taken east of Cedros Island (Stations 125, 126 and 127) in depths of 38 to 60 fathoms, as follows: Station 125: D-1 (7 ♂, 1 ♀); Station 126: D-2 (4 ♂, 6 ♀), D-3 (21 ♂, 12 ♀), D-4 (1 ♀), D-10 (1 ♀); Station 127: D-1 (6 ♂, 4 ♀). Cat. Nos. 361,020, 361,021, 361,022, 361,023, 361,024, 361,025.

Dimensions and Sexual Condition: Females ranging in length from carapace 27 mm., total length 105 mm., to carapace 7 mm., total 30 mm. Males ranging in length from carapace 22 mm., total 86 mm. to carapace 5 mm., total 20 mm. There is no clear evidence of local segregation as to size or sex. The petasmal endopods are of adult form and are joined together in males down to 10.5 mm. in carapace length.

Diagnosis: Antennal angle with a buttressed tooth; dorsal carina of the second pleonic somite not incised; basis and ischium of the first chelipeds unarmed. The carapace is armed with two middorsal teeth, one before and one behind the level of the hepatic spine; the rostrum is armed above with three teeth and has a bifurcate tip.

The rostrum is more than one-third as long as the carapace and is distally quite slender; it is proximally decurved, but the tip is often turned up somewhat at an angle to the proximal part. The lateral ridge of the rostrum parallels the ventral margin of the blade throughout its length. The ridge (cardiacobranchial) extending posteriorly on the sides of the carapace from behind the hepatic spine, is conspicuous, especially in large individuals.

The telson is long and slender, the width of its base being no more than a quarter of its length; and is armed with a conspicuous pair of fixed lateral spines. The middorsal carina of the fifth pleonic somite descends very gently at its posterior end. The anteromedian pleural sulcus of the first pleonic somite is faintly continued below its well-defined dorsal section as a very shallow depression. The pleural margin of the first pleonic somite, anterodorsal to the ventral angle, is straight.

The dorsal surface of the distal part of the ocular peduncle bears, near its distolateral margin, a pencil of hairs which when unbroken reaches far beyond the eye in large adults, although it is sometimes much shorter in small specimens. The terminal segment of the antennal peduncle is very

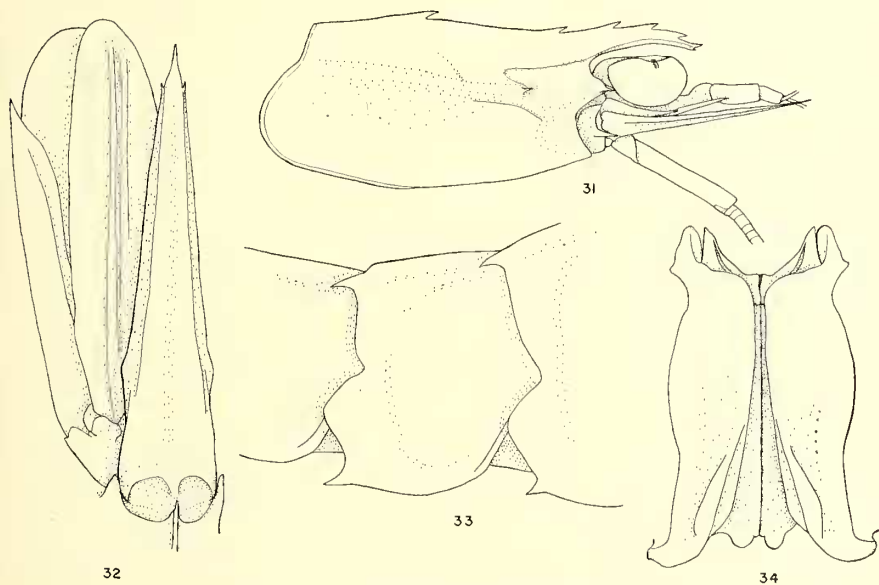
long and slender, its diameter being no more than one-fifth its length. The telson does not extend as far as do the uropods in adults, although it may exceed them in juveniles.

The blunt-tipped distoventral projections of the petasma bear a shallow proximolateral prominence, distal to which the projections extend parallel to and nearly or quite as far as do the distolateral lobes. The distolateral lobes are divergent from the median plane.

The depressed median interspace between the raised posterolateral parts of the buttress of the median spine of the thirteenth sternite in the female is little if at all wider than are the raised parts. The spine between the first pleopods of the female is broadly subtriangular in ventral outline, with convex lateral margins.

Remarks: The length attained by *E. ingentis* is somewhat greater than seems heretofore to have been recorded for the subfamily, although the animal, being a relatively slender one, is outbulked by the corpulent species next it in length, *E. brevirostris* (Stimpson).

Eusicyonia ingentis is closely related to *E. dorsalis* (Kingsley) and its Pacific congener *E. disdorsalis* Burkenroad, from which it is most strikingly distinguished by the form of its petasma. Aside from being a much larger species, its habitus is relatively more elongate and slender than in the related forms, a tendency particularly pronounced as regards rostrum, telson, and antennal peduncle. The details in which *E. ingentis* differs most markedly from *E. disdorsalis* are those listed in the paragraphs of the diagnosis subsequent to the first; thus in *E. disdorsalis* the lateral ridge of the rostrum usually arches up from the ventral margin near the distal end; the broad ridge posteriorly continuing the hepatic buttress is ill-defined; the lateral teeth of the telson are very minute and inconspicuous, especially in large



Text-figures 31-34.

Eusicyonia ingentis, n. sp. **31.** Carapace (lateral view); juvenile ♀, D. T. R. 361,021, x 4.5. **32.** Telson and right uropod (dorsal view); adult ♂ of total length 64 mm., D. T. R. 361,021, x 4.5. **33.** Fifth pleonic somite (lateral view); as in 32, x 4.5. **34.** Petasma (posterior view); as in 32, x 10.

specimens; the posterior end of the dorsal carina of the fifth pleonic somite is in adults sharply angular, although in juveniles it may descend gently; the anteromedian pleural sulcus of the first pleonic somite is not continued below its well-cut dorsal section; the anteroventral pleural margin of the first pleonic somite is concave in adults, although it is straight in juveniles; the pencil of setae on the dorsal surface of the ocular peduncle extends no more than half way across the cornea; the telson exceeds the uropods; the distolateral lobes of the petasma curve toward the midline; the proximolateral ramus of the distoventral projection of the petasma exceeds the acute, laterally directed distal part in size; the depressed area of the base of the spine of sternite XIII of the female is much wider than the raised parts flanking it; and the tooth between the first pleopods in females is narrow and usually with concave lateral edges.

At dimensions at which *E. ingentis* is juvenile, with minute undeveloped petasmal endopods, *E. disdorsalis* presents all the characters of maturity.

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